Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIV. NEW YORK, SATURDAY, SEPTEMBER 10, 1904. No. 11.

ELECTRICAL WORLD AND ENGINEER.

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
ST. LOUIS HEADQUARTERS, Section 1, Electricity Building, Louisiana Purchase Exposition.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico - - - - - -	Per year, $3.00
Foreign Countries, within the Postal Union - - - - - - -	6.00
Great Britain and Ireland - - - - - - - - - -	25 shillings
Germany - - - - - - - - - - - - - - -	25 marks
France - - - - - - - - - - - - - - - -	31 francs
Single copies - - - - - - - - - - - - - -	.10

Remittances for foreign subscriptions may be made through our European office.
In requesting your address changed give OLD as well as new address.

Copyright, 1904, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, SEPTEMBER 10, 1904.

CONTENTS.

Editorial 403
Convention of Association of Edison Illuminating Companies 406
The Northern California Power Company's Systems—I..... 407
Reception and Entertainment of the Electrical Engineers from Abroad... 411
Delegates to the International Electrical Congress, St. Louis, 1904..... 411
Wireless Telegraph Fact and Fiction 418
A Physical Conception of Some Alternating-Current Phenomena—III (concluded). By Lamar Lyndon 419
The German Electrical Exhibits at the World's Fair—II. By Franz Welz 421
The Status of the Electrical Contractor. By A. H. Scott 423
The Growing Duties and Responsibilities of the Municipal Electrician. By Capt. Wm. Brophy 424
Recent Electrochemical Developments 426
New Telephone Patents 426
Electricity at the World's Fair 427
Current News and Notes 427
LETTER TO THE EDITORS:
Electrical Nomenclature. By A. S. McAllister 428
Digest of Current Electrical Literature 428
New Books 431
The Turbo-Electric Power System in Paint Manufacture 432
Storage Battery Exhibit at St. Louis 435
The Holophane Exhibit at St. Louis 436
Electric Savings Banks 437
Relation of Electric Heating Devices to Central Stations..... 438
Condensers in the St. Louis Fair Plant 440
New Type of Lightning Arrester 440
Water Tube Boiler 441
"New England Motor" Storage Batteries 441
New Type Annunciator 442
Press with Dial Feed 442
Ceiling Switch 442
Power and Machinery Company's Gas-Electric Plants 442
News of the Week 443

THE EVE OF THE INTERNATIONAL ELECTRICAL CONGRESS OF ST. LOUIS.

Now that the Fifth International Electrical Congress is about to convene, it is worth while reviewing the auspices under which it assembles. The numerical strength of the Congress is far in excess of any of its predecessors. The acceptances of membership are stated to be 2,050, of which more than 400 are from foreigners. This is more than double the membership of the fourth Congress, held at Paris in 1900, which, in its turn, had more than double the membership of the third Congress, held at the Chicago World's Fair. The number of specially invited papers forthcoming appears to be over 150, of which about 110 have already been delivered. It is expected that nearly 100 papers will be in type at the Congress meetings, the remainder being read from manuscript, owing to tardiness in delivery. The papers appear to be of generally high type, and distinctly superior in quality to those that are met with in Congresses where all the papers are volunteered. A noticeable feature of the Congress is the number of scientific and technological societies that are taking part in the proceedings. These comprise the Royal Societies of England and of Canada, as well as the American Physical Society in the direction of pure science; while in applied electrical science there are five European and six American societies coöperating with the Congress.

The average number of papers in each section will probably be about twenty, for the reading and discussion of which four and one-half sessions are provided, representing an average schedule of four or five papers a day. According to the programmes which have been issued to the membership, two topical discussions are likely to be provided—one for the Institution of Electrical Engineers from England in conjunction with the American Institute of Electrical Engineers and Section A of the Congress on the subject of electrical and magnetic units; the other for the same two Institutions, in conjunction with Section F of the Congress, on the subject connected with the best transmission and distribution of electrical power for electric railways. The introduction of the Congress sections into these discussions will not only give an opportunity for Congress members generally to take some part in the discussion; but will also enable the discussions between the two Institutions to be printed in the Congress Transactions.

As regards the Chamber of Government Delegates, there have been some fifteen appointments to this body, and it is still possible for others to follow. It is difficult to forecast the action that this chamber may take after it convenes. It may on the one hand decide to lay all suggestions on the table for some future Congress to consider; or it may, on the other hand, decide to effect a complete series of decisions on the various points suggested for its consideration. There seems to be at least five such questions. First, the question of the legal value of e.m.f. of the Clark standard cell (1.434 volts), as enunciated by the Chicago Congress; whether this should be changed, and if so, whether it should be altered to, say, 1.433 volts, provisionally at least. Second, whether any value should be adopted for the e.m.f. of the cadmium cell. Third, the question of magnetic units, whether any new names should be adopted for them. Fourth, the question of general nomenclature for fundamental C. G. S. electric and magnetic units, whether any names should be permitted or adopted for them. Fifth, the question of international notation; or whether any steps should be taken to avoid conflict between electrotechnical

notation and electrochemical notation. It is evident that there is ample opportunity for discussion on a budget such as has been outlined above. The question is whether the Chamber of Delegates will face the problem of undertaking the consideration of the questions. Whatever may be the course adopted in these matters, there can be no doubt, judging from the papers already contributed by so many prominent electrical workers, that the Transactions of the Congress will possess great value, both for immediate reading and for permanent reference. We wish the St. Louis Congress all the success it greatly deserves.

GYROSCOPIC COLLIMATORS.

One of the problems that the navigator has to face, when out of sight of land, is the determination of his position on the ocean by means of observations of the altitude of sun or stars above the visible horizon. These observations become a matter of daily routine, presenting no unusual difficulties in bright daylight. But at night time, and in hazy daylight, the horizon becomes obscured, so that the elevation of the visible body becomes indeterminable. Various expedients have been tried from time to time to secure an artificial horizon on board ship when the natural horizon fails; but with very little success owing to the movements of the vessel, until the Fleuriais gyroscopic collimator was devised. This instrument is in limited practical use and has been reported upon in France. The device is a little air-turbine mounted on the frame of a sextant held by the observer in the ordinary way. The little turbine is about one inch in diameter, and runs on a vertical pivot like the ordinary spinning top. Its normal speed is about 100 revolutions per second. The turbine axis at this high speed tends to become vertical. In ordinary terms, the top tends to spin upright. An illuminated scale and opposed lens on the turbine thus tend to supply a horizontal line or artificial horizon to the telescope.

In the use of the apparatus, the turbine is brought up to speed by a small exhaust-pump, the air in the turbine chamber is then partially exhausted and the turbine allowed to run in the partial vacuum. The pump is then disconnected and the apparatus is said to be capable of use for many minutes subsequently without repumping. The centre of gravity of the turbine is about half a millimetre below the pivot-point support; so that the turbine, at rest, behaves like a very short pendulum, with correspondingly quick swing. The rapid spinning of the turbine, however, virtually converts the device into a pendulum of relatively great length and much slower swing. The extreme limits of the swing are noted in each observation and the mean thus obtained approximates to the true horizon. There seems to be a good opportunity for replacing the pneumatic driving power of the instrument by electric power from a storage cell.

A REMARKABLE ENGINE TEST.

It used to be said that "Competition is the life of trade," to which has been frequently added, "And the death of profit." But there can be no doubt that good active competition will advance technical art at a greater pace than can be reached by any other sort of stimulus. Long prosperity and lack of competition combine to produce a policy of the sluggish and self-complacent sort, sometimes disguised under the euphemistic name of standarization. It is an excellent change when something unexpected comes along and shakes up the dry bones of an industry. We have no doubt that the introduction of the steam turbine, quite apart from its great intrinsic importance, will advance the cause of improvement in prime movers to an extent that people as yet little appreciate. In particular it has brought to the front the value of high vacuum, superheating, and high rotative speed in furthering the cause of economy. The result of the kick thus administered to the engine builders has been greatly increased activity in improvements of which we have seen a startling example in the tests recently published abroad upon a Willans triple-expansion engine. The type has been long well known as particularly fitted by its high speed for direct-connection to dynamos, and also as unusually economical of steam, but the present record is something very much out of the ordinary. Even 10 lbs. of steam per hp hour at full load is quite sufficiently remarkable, but 10.8 lbs. at three-quarters load and 11.8 lbs. at half load are figures which add lustre to the performance, particularly when one realizes that the full-load rating of the machine was only 210 hp.

These very remarkable results were obtained with steam at 185 lbs., 28-inch vacuum and 260 degrees F. of superheating. Without superheating the steam consumption at full-load rose to 14.6 lbs.—itself no contemptible figure for so small an engine. The upshot of the matter is that by combining high rotative speed (400 r.p.m.), good vacuum and high superheating, it has been possible for this little reciprocating engine to reach the almost mythical point of giving a hp-hour per pound of coal consumed; for although the test did not include coal consumption, the well-known results of boiler performance leave little doubt upon this point. And what is more, a prime mover at this rotative speed can readily be directly coupled to a direct-current generator of very moderate bulk and cost, and the combination would give the kilowatt hour at an expenditure of steam dangerously near the best recorded for turbines of twenty times the output. The fact is that superheating has at last become an important factor in the power situation, after having been for a long time denounced as "theoretical" or "impracticable." The objection generally raised against it is a reputed difficulty of proper lubrication. It is pretty well understood that this trouble, undoubtedly real sometimes, has now become in the main imaginary. And even granting that it has not been completely suppressed, it may safely be said that with the stimulus which has now been applied, any remaining difficulty will be made short work of. Besides, the gas engine has had a similar problem in lubrication to be solved, and the results obtained have been, on the whole, good, so that one must look for a prompt suppression of the residual troubles in lubrication.

Now, taking all this into account, what does the Willans test really mean? That the final superiority of reciprocating engines has been demonstrated? That high superheating is a panacea for all the economic ills that engines are heir to? That the results are merely theoretical "as the results of engineers' tests"? Probably none of these. The tests are, it is true, strictly tests and not the results of continuous runs over long periods. The same objection stands against nearly all the data on turbines and gas engines—in fact, all prime movers are on a basis of equality in this respect. But the tests show very clearly that the same tactics of pushing up vacuum and superheating which have been successful in improving turbine efficiency, can be applied to ordinary engines with remarkable success. And they also show that with properly designed reciprocating engines the efficiency can be kept good over a considerably wider range of load than is generally supposed to be feasible. Engines of the type concerned occupy in speed, bulk and weight a place intermediate between ordinary engines and turbines. They have now been shown to be substantially the equal of either in actual efficiency. They therefore provide the engineer with another resource in his fight for cheap power. They also furnish another practical proof that in steam motors generally the efficiency is mainly dependent on the initial and final temperatures of the working fluid, as theory would indicate. The internal combustion engines reach far higher efficiencies, but do it at the expense of far higher maximum temperatures. From the thermo-

dynamic standpoint they have the advantage and can retain it if they can deal with the required temperatures. This, like extreme superheating of steam, is a purely practical question to be settled upon its merits. At some point the impossible will be reached, but meanwhile we have in sight very material improvements along several lines, for which all thanks.

INDUSTRIAL ILLUMINATION.

It is curious to note how slowly modern methods in illumination penetrate the thick crust of conservatism that covers many industrial establishments. In the last ten years to be sure the open arc nas passed largely out of use, to be replaced by enclosed arcs, but the incandescent lamp has in that time changed in character and use surprisingly little. The loss of the open arc even is from the consumer's standpoint a somewhat dubious gain, since the enclosed arc, in spite of its steadiness, is considered by many as of most undesirable color, especially in the smaller sizes, and as still too brilliant for giving a well distributed illumination. In most industrial establishments a deeply colored light is objectionable in the extreme, and distribution is of especial value, so that, really, enclosed arcs must be used with great caution. Incandescents leave much to be desired in point of efficiency, and are pushed hard in the matter of cost by various incandescent gas burners, with which the arc can successfully compete. There is surely need enough for improvement despite the labor that has been spent in bringing the present devices to their best forms. Of the recent illuminants, which are now being exploited, none has yet come into extensive use for industrial lighting. The Nernst lamp, understood to give most satisfactory results in steadiness and economy, has not forced its way into anything like the extensive use that might have been expected. The mercury arc and other plans for lighting by incandescent vapor are not yet in anything but casual use, and the magnetite arc and others of the flaming type have hardly made a beginning.

The cause of this slow adoption of new illuminants apparently of very great usefulness is somewhat difficult to discover. Perhaps in the case of the Nernst lamp, which surely gives a most beautiful light at good efficiency, the controlling factors have been the rather high first cost of the lamp and the fact that like an arc lamp it requires a certain amount of care. The mercury arc is, generally speaking, discouraged by its color, although in certain kinds of industries this is not a very serious matter. The flaming arc in all its forms appears to require some extra care, and although admirably efficient seems scarcely to have arrived as yet. At all events the bulk of industrial lighting is done strictly along the old lines with the arc as its mainstay and the incandescent to fall back upon. Having these at hand one would suppose that a great deal of skill in using them would have been evolved, but on the contrary there is far less than could be desired. The fact is that industrial illumination is in a highly unsatisfactory state. The fundamental requirement is steady light, of color not inconvenient for the work attempted and distributed so as to give sufficient light at every point. Looking over various establishments to examine the adequacy of the result one usually finds the conditions imperfectly realized. Sometimes there is an ample amount of light badly distributed, sometimes well distributed light of objectionable quality. To our mind the commonest fault in the illumination of business places and industrial establishments is the unwise use of enclosed arcs. There has been in evidence of late a mania for extreme subdivision of the arc which has led to rather questionable results. An enclosed arc of even 6 to 8 amperes gives a light of a strong bluish violet tone, which is less desirable for general purposes than the whiter light of the open arcs, although excellent for street lights. But when the current is cut down to 5, 4 or even 3 amp. the color of the light gets so bad as seriously to detract from its usefulness unless heavily shaded, and when shaded so as to improve the color tone the efficiency is reduced below that of a first-class incandescent lamp. The case is bad enough even with a direct current lamp, but with the alternating arc it is worse both in color and efficiency. Just why there has been this popularity for little arcs it is hard to say. It sells more lamps to be sure, but in the long run it may be bad for electric lighting. Small arcs are used abroad, but they are mostly in open direct current lamps and give a beautiful white light, the carbons being small enough to give a good current density in the arc. The care required is a considerable item, from the American point of view, but the results in illumination are good. To tell the truth, the enclosed form of arc in small sizes is far better for the supply company than the consumer. Nothing smaller than a 6 ampere, direct-current arc will really fulfill the requirements of the arc, and in alternating current working the current should be a couple of amperes greater. In fact, the best enclosed arc, from the standpoint of the user, is the one worked with as high a current as the inner globe can safely stand. Anything less deteriorates the color and injures the efficiency.

Obviously these particular arcs must be used with great discretion in order to get decent distribution, and the burden of this complaint is the need of studying indirect diffused lighting in order to avoid the necessity of using arcs, if at all, in units too small for good results. If one uses indirect lighting in which the illuminant is practically hidden, he is at liberty to use units of any power with clear globes. The loss of light in a good diffusing system is scarcely more than in the shades necessary with direct lighting from arcs, and the net result is incomparably better. There is no doubt that a lot of small arcs well shaded give at first glance a brilliant effect and enable excellent photographs of the magnificent effects to be secured, but the illumination is obtained at a high cost, and all photographs taken by enclosed arcs are utterly deceptive in giving real illuminative values. On the other hand, diffused lighting from powerful light-units, particularly if concealed, is anything but sensational in its appearance, does not dazzle the newcomer's eye, and, in fact, does not show at its real value. Hence it is hard to educate the public up to the point of preferring the less sensational but more effective method. The work is gradually going on, however, and it will not go backward. The beauty of the method is that the new lights like the Nernst and the flaming arc can be used unshielded and in big sizes for diffused lighting, thereby enabling the general efficiency to be very materially raised. For instance, an efficiency equivalent to three or four candles per watt is claimed for some recent arcs. Light of this intensity can only be effectively used by deep shading if the lamps are exposed, but when used entirely by diffusion, can be made highly efficient as compared with ordinary arcs. At even a candle per watt one can lose fifty per cent. in the diffusion and still come out far ahead of ordinary enclosed arcs and incandescents, and at the better figures the winnings are large. If some inventor should patent a new incandescent lamp giving a candle power steadily for two watts the whole light using public would tumble over itself to secure the improvement. But this efficiency can be reached by diffuse lighting from powerful arcs without any particular difficulty, and it is high time the fact was appreciated. In industrial work there is always need for some local lighting in addition which can be obtained from incandescents or any other familiar source, but in the large work it is high time for the powerful light used indirectly to come into its own. When the new sources with small units at high efficiency really arrive they will find a place and a welcome.

Convention of Association of Edison Illuminating Companies.

The Association of Edison Illuminating Companies held its twenty-fifth convention at the Hotel Wentworth, New Castle, N. H., August 30, 31 and September 1, 1904. The meetings were presided over by President J. B. McCall, of Philadelphia. Interest in the proceedings was well sustained, and there was a very complete attendance of the delegates at each session. All the papers on the programme were read and elicited full discussion. President Edgar, of the Boston Company, extended an invitation to all the delegates to join in the reception to the foreign electrical engineers in Boston on September 2 and 3.

The attendance was the largest in the history of the association, the following companies being represented by the gentlemen named:

General Electric Company—C. A. Coffin, Eugene Griffin, Elihu Thomson, J. R. Lovejoy, Schenectady, N. Y.; B. E. Sunny, Chicago; E. D. Mullen, Philadelphia; Fred M. Kimball, Boston, Mass.; Charles P. Steinmetz, Schenectady, N. Y.; William Le Roy Emmett, Schenectady, N. Y.; Caryl D. Haskins, Schenectady, N. Y.; Wallace S. Clark, Schenectady, N. Y.; Walter D. A. Ryan, Lynn, Mass.; George F. Morrison, A. D. Page, Francis W. Willcox, Harrison, N. J.; Sidney B. Paine, Boston, Mass.; George H. Stickney, Lynn, Mass.; Charles A. Mosman, A. L. Rohrer, W. S. Andrews, Schenectady, N. Y.; Clyde A. Houghton, Lynn, Mass.; Martin J. Insull, Pittsfield, Mass.; Harry J. Buddy, Philadelphia, Pa.; P. D. Wagoner, H. W. Hillman, E. F. Gilbert, H. C. Wirt, Schenectady, N. Y.; E. H. Mullin, New York; F. N. Boyer, Chicago; F. P. Cox, Lynn, Mass.; Theodore Beran, New York; F. C. Bates, New York.

Edison Electric Illuminating Company, Boston—Charles L. Edgar, A. S. Knight, William H. Atkins, W. H. Francis, J. W. Cowles, Herbert A. Wagner, New York; Welles E. Holmes, Newton, Mass.; La Rue Vredenburgh, Sidney Hosmer, Charles H. Parker, Arthur G. Pierce, Leonard L. Elden, Boston; Gerhard M. W. Goettling, R. S. Hale, Charles H. Herrick, John S. Vogler, W. P. Hancock, Charles J. Hatch, Crawford R. Brown, F. Ellwood Smith.

Chicago Edison Company—Samuel Insull, Walter M. Anthony, Peter Junkersfeld, George N. Eastman, Ernest Lunn, Robert C. P. Holmes, John W. Ferguson, Edwin J. Fowler, W. G. Carlton.

Edison Electric Light Company, Philadelphia—Joseph B. McCall, Joseph D. Israel, William C. L. Eglin, William F. Harrity, Charles J. Russell, John W. Meyer, P. H. Bartlett, Howard K. Mohr.

New York Edison Company—Thomas E. Murray, H. M. Edwards, Robert A. Carter, A. H. Ackermann, Arthur Williams, Walter F. Wells.

Edison Illuminating Company, Detroit, Mich.—Alex. Dow, Hoyt Post, Samuel C. Mumford, John W. Brennan.

Edison Electric Illuminating Company, of Brooklyn—E. A. Leslie, W. W. Freeman.

New Bedford Gas & Edison Light Company—George K. Stetson, Charles R. Price.

G. W. Brine, Georgia Railway & Electric Company, Atlanta, Ga.; Leon H. Scherck, Birmingham Railway, Light & Power Company; Byron T. Burt, Chattanooga Electric Company, Chattanooga, Tenn.; W. H. Johnson, Beacon Electric Light Company, Chester, Pa.; Louis A. Ferguson, Commonwealth Electric Company, Chicago; Mathias E. Turner, Cleveland Electric Illuminating Company; J. H. Lovejoy, Des Moines Edison Company, Schenectady, N. Y.; Thomas G. O'Dea, Erie County Electric Company, Erie, Pa.; Harry Bottomley, Fall River Electric Light Company, Fall River, Mass.; Charles C. Perry, Indianapolis Light & Power Company, Indianapolis, Ind.; James B. Foote, Jackson Light & Power Company, Jackson, Mich.; J. W. Reeves, Citizens' Light, Heat & Power Company, Johnstown, Pa.; A. M. Worthington, Louisville Lighting Company, Louisville, Ky.; R. S. Wallace, Peoria Gas & Electric Company, Peoria, Ill.; W. S. Barstow (Portland General Electric Company, Portland, Ore.), New York; M. A. Beal, Rockford Edison Company, Rockford, Ill.; W. F. White, Union Electric Light & Power Company, St. Louis (Missouri Edison Electric Company), New York; William Chandler, Edison Sault Electric Company, Sault Ste. Marie, Mich.; Dwight P. Robinson, Seattle Electric Company, Boston; G. H. Edes, J. R. Lovejoy, Edison Electric Light Company, Schenectady, N. Y.; F. G. Sykes, Schenectady Railway Company, Schenectady, N. Y.; D. L. Huntington, Washington Water Power Company, Spokane, Wash.; E. J. Bechtel, Toledo Railways & Light Company, Toledo, Ohio; H. W. Fuller, Potomac Electric Power Company, Washington, D. C.; Ernest H. Davis, Edison Electric Illuminating Company, Williamsport, Pa.; Wilson S. Howell, Electrical Testing Laboratories, New York.; Clayton H. Sharp, Electrical Testing Laboratories, New York; W. F. Little, Electrical Testing Laboratories, New York; Herbert Lloyd, Electrical Storage Battery Company, Philadelphia; G. H. Atkin, manager Electric Storage Battery Company, Chicago; John R. Williams, Electric Storage Battery Company, Philadelphia; Forrest E. Barker, Massachusetts Board of Gas & Electric Light Commissioners, Boston, Mass.; T. F. Flanagan, United States Navy Yard, Portsmouth, N. H.

The following officers were elected for the ensuing year: President, Joseph B. McCall; vice-president, D. L. Huntington; treasurer, Alex Dow; secretary, E. A. Leslie. Executive Committee—Samuel Insull, John W. Lieb, Jr., C. L. Edgar, L. A. Ferguson, G. W. Brine.

Mr. G. E. Eastman presented a paper on "Economies in the Operation of Enclosed Arc Lamps." Only direct-current, enclosed arc lamps, with solid carbons, were considered. The statements contained in the paper are based on tests. All tests for carbon consumption were made on the four-hour basis—the carbons being weighed before and after the tests. The carbon consumption in the enclosed arc lamp depends primarily upon the leakage of air in bulk and the character of the carbon and is affected very little by increasing the current from 3 to 6 amp. or by increasing the voltage from 70 to 120 volts. It was noted that when burning a 3/16-in. carbon with 6 amp. and 80 volts at the arc a mushroom would be formed on the lower carbon, whose weight increased with further burning. Apparently the mushroom formation is obtained with a current density at which the lower carbon ceases to be consumed. It would appear that the maximum efficiency is obtained when the lamp is operated with the maximum current which can be maintained without producing the mushroom formation. Under these conditions there would be practically no consumption of the lower carbon, and the arc would remain in a fixed position in the globe.

Mr. P. Torchio presented a paper entitled: "A Plea for the Standardization in Construction and Operation of High-Tension Systems." It was intended to open the discussion upon some of the vital points of construction and operation of high-tension systems, which must sooner or later receive final settlement, and the sooner the better. The New York Edison Company, after eighteen months of multiple bus operation, went back on May 1 to the single bus operation. This method of operation will not modify the necessity of sectional buses for emergency conditions. A second requirement for safety of service is the independent operation of high-tension feeders in sub-stations. The New York Edison Company has adopted duplicate high-tension buses for each feeder, one main and one emergency bus. For the operation of low-tension networks, the solid-meshed system is certainly advantageous in case of local trouble met under normal operation. In the emergency of a possible complete shutdown, separate districts, one for each sub-station, would be preferable. Several types of safety devices are described in detail.

J. W. Cowles read a paper on "Experiences with Electric Automobile Charging Stations." In order to be able to supply current to automobile batteries, the Edison Electric Illuminating Company, of Boston, installed numerous charging stations in livery stables in the various towns of the neighborhood. The equipment of each consisted of a 6½-kw, single-phase motor-generator set of the Wagner type, operated from the lighting circuits. The switchboard was provided with a double set of charging posts, each with a regulating rheostat and recording wattmeter, so that two vehicles might be charged at once if needed. An important feature was the placing of suitable signs on the poles along the principal lines of travel directing toward the nearest charging station. The customer is charged on the wattmeter reading at 10 cents per kilowatt-hour, though no charge is made for less than 30 cents. Troubles encountered have been due mainly to lack of information on the part of operators of vehicles and to the low grade of intelligence generally employed about livery stables. Bicycle repair shops would seem to be the ideal location for charging stations.

Mr. W. C. L. Eglin read a paper on "The Relative Efficiencies of Electric and Hydraulic Elevators." It contained reports of numerous tests on hydraulic and electric elevators, which tests show wide differences in the current consumption of the various electric types, and illustrate the necessity for securing all the detailed information required in computing the cost of elevator service. The criticism of electric elevators is that they are limited as to length of car travel by mechanical limits of the stresses on the drum.

The Northern California Power Company's Systems.—I.

THE Northern California Power Company was incorporated March 18, 1902, primarily to take over and operate the properties of the Keswick Electric Power Company. Since that date the general policy of the company has been one of expansion, as regards not only the construction of new plants and enlargement of its distributing system, but also the acquisition of the property of all the smaller companies in the same line of business in the territory which it covers.

As a result of this expansion it is the most important concern occupying the lighting and power field of the northern section of the State. In fact, its importance is secondary only to that of the California Gas & Electric Corporation, so generally termed the Bay Counties system. In regard to magnitude, the Northern California system ranks fourth in the State of California, for its size is exceeded only by those of the Bay Counties system and the systems of the Edison and Pacific Light & Power Companies of Southern California. The Northern California system has succeeded to the interests of the Redding Water Company, the Redding Gas Company, the Red Bluff Electric Light & Gas Company, the Tehama Electric Company, of Red Bluff, and the Bellevue Irrigation Company, which operates an extensive irrigating system using water pumped by electric power in and about the town of Anderson. The steam plants formerly operated by these various companies have all been abandoned and service is now rendered exclusively from the long-distance, high-tension lines of the Northern California Power Company, but separate gas works are maintained in Redding and Red Bluff. In all, the company operates 228.4 miles of high-tension transmission circuit, reaching from De La Mar on the extreme north to Willows on the south, and while power for the system is at present supplied from the Volta hydro-electric station—otherwise known as the Shingletown or Battle Creek plant—by the time this article reaches the hands of its readers the second plant, known as the Kilare station, or Cow Creek plant, will be in operation. These two water power plants have a combined capacity of 5,250 kw at normal rating and each of them possesses peculiar individualities which make it ideal in several important respects. Particularly is this true in the matter of water development, for in each plant the hydraulic end is characterized by exceeding shortness of its canals, coupled with great height of head and absolute reliability in water supply. As to the Shingletown plant, imagine, for instance, a station turning out upward of 3,000 hp from water derived from springs located in a mountainous country varying in altitude from 3,200 to 5,000 ft. above sea level, and which is deluged with rain that reaches a precipitation as high as 70 in. in a period of time aggregating less than three weeks, and the ditch system of which is attended to by one man.

The neucleus of the Northern California Power Company rested in the Keswick Electric Power Company, organized in 1900, primarily for the purpose of supplying electric power for the operation of the smelters of the Mountain Copper Company, at Keswick (pronounced locally as Kes-sick), and secondarily to take on the electric lighting and power load of the city of Redding. It was the Keswick Electric Power Company which built the Volta plant, which began operation on November 28, 1901, and its seniority entitles it to prior description.

THE VOLTA HYDRO-ELECTRIC SYSTEM.

Like a great promontory jutting far out to sea is the tongue of lava that one time flowed down from Lassen Peak toward the mighty valley of the Sacramento. Lassen Peak, reaching to an altitude of 10,437 ft. above sea level, has a store of water that never fails, water everywhere coming from springs of such size that a single one makes a seeming river. At the lower extremity of the plateau is collected the waters of Millseat, Alpine, Berry and Battle Creeks—all sizeable streams that rise from unfailing springs—for the operation of the Volta power house.

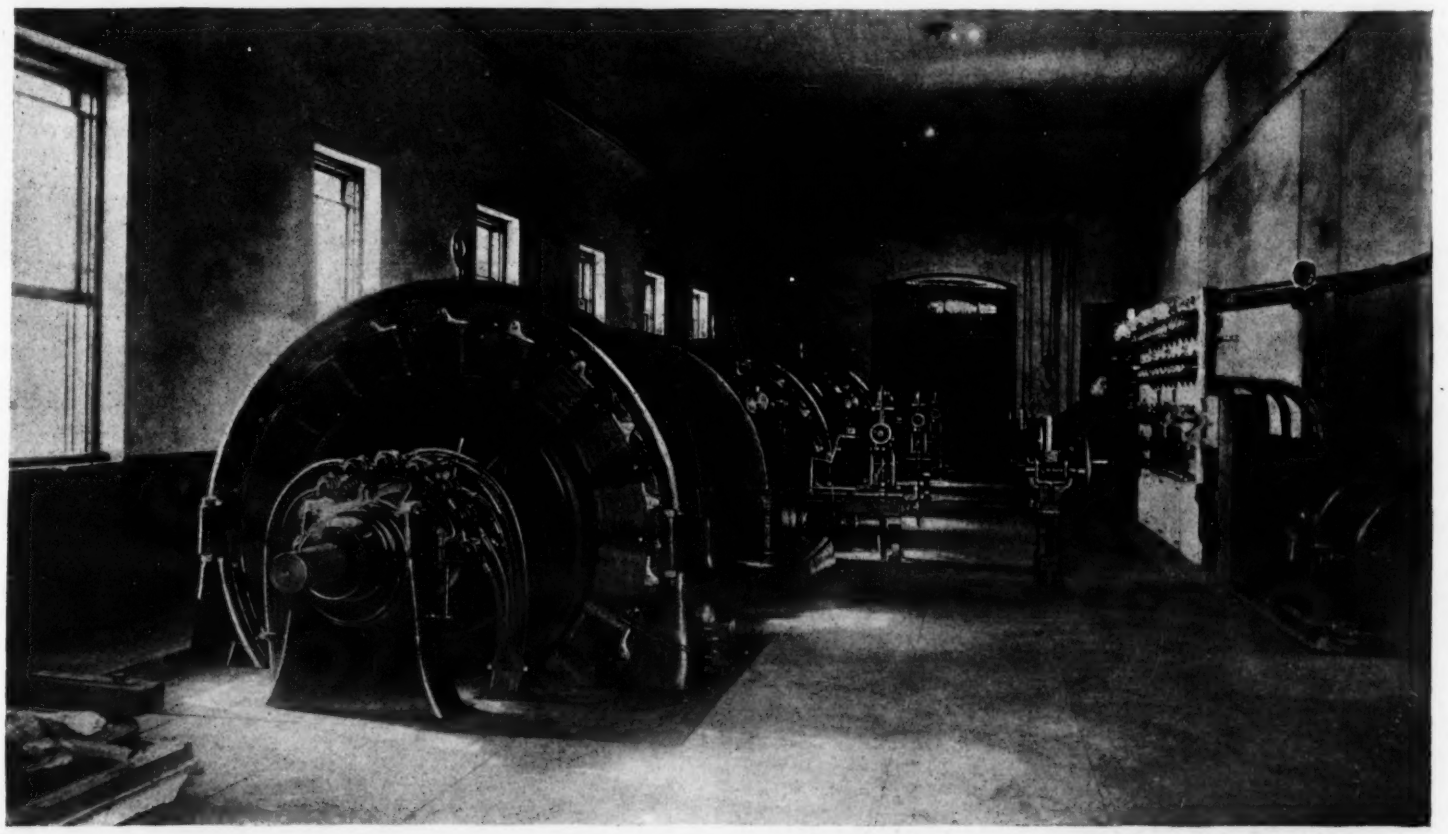


FIG. 1.—INTERIOR OF VOLTA POWER HOUSE.

It was the writer's good fortune to visit practically every water power plant of importance in the West, but nowhere has he seen natural conditions so favorable to reliable water development as those found in this locality. Battle Creek—to be exact, it is the North Fork of Battle Creek—is the main artery for the watershed, which has an area of 85 square miles, and into it flow innumerable small streams that come up from the ground and wind their ways first joyously through the forest, then angrily down the canyon to the common goal. Millseat, Alpine and Berry Creeks are such as these, but their short cut to Battle Creek has been barred, for now they must earn their right to reach it.

The headgate to the water system is on Battle Creek (Fig. 2) whence water is taken by a simple diversion into a canal that runs down the side of the canyon for a distance of about a mile. Then it turns slightly more to the west, when, after a further three-quarters of a mile, it flows into Berry Creek. The latter carries the water practically a thousand feet, when the flow of both streams is

picked up by a short ditch, probably 1,500 ft. long, which in turn empties into Alpine Creek. Again the same performance is repeated, for soon the Galpin Creek ditch picks up the water of the three streams and carries it for nearly half a mile to Millseat Creek, which now contributes its quota to the flow. Millseat carries the water for another thousand feet, when the main canal is reached, and in another half mile comes Lake Nora, the reservoir-penstock of the plant. Then 800 ft. of wooden stave pipe to the bungalow, and 6,000 ft. of steel pipe to the power house, which the water reaches under a head of 1,200 ft. In all there has been traversed 3.5 miles of canal, 6,800 ft. of pipe line, and not an inch of flume, tunnel, trestle nor steep side-hill ditching. In addition, Battle Creek furnishes sufficient water for the operation of the plant at full load at all times, and during more than half of each year, either one of the smaller creeks similarly furnishes enough water for the operation of the plant, so that come what may, the wheels at Volta will never be without all the water they require so far as the canal is concerned.

The complete development of the water system is shown in the map presented as Fig. 2, to which naught can be added beyond that

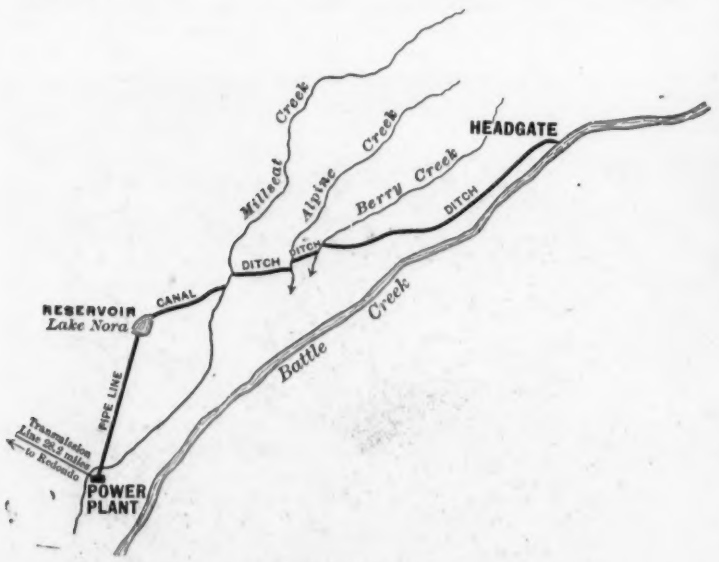


FIG. 2.—HYDRAULIC DEVELOPMENT AT VOLTA PLANT.

already said. All ditching therein is like that of the main canal, as seen in Fig. 3, though the ditches of the upper end of the system are not quite so large. In the main ditch, or that running from Millseat Creek to Lake Nora, the area of the water section is 18

FIG. 3.—ALPINE CREEK DITCH.

sq. ft., and with a gradient of one-quarter of an inch per rod. The calculated velocity of the water therein is 2.34 ft. per second, the volume of water being 42.12 cu. ft. per second. Lake Nora is a small reservoir in among the pines, which has a sufficient storage capacity to carry the plant under full load for about ten hours, or long enough to enable the canal to be cleaned in sections. As for repairs, the canal will never need them. The intake for the pipe line is out near the center of the lake in a timber, rock-filled crib that supports a large wooden headgate controlling the flow of water into the pipe. This crib also supports two screens, the first of 1-in. bars and the second of 1¼-in. wire mesh, which may easily be removed for cleaning, one at a time. The gate is controlled by an iron stem with nut and hand wheel device, the pressure being carried on roller bearings. For 800 ft. beyond the intake the ground slopes very gradually and in this distance the water is taken through a 42-in. redwood stave pipe (Figs. 4 and 5). The remaining 6,000 ft.

FIG. 4.—MAKING THE REDWOOD STAVE PIPE.

of the pipeline is, as stated, of steel, being of the lap-welded, riveted variety, 30 in. in diameter and varying in thickness from ¼ in. at the upper end to ⅝ of an inch at the power house, the maximum head being 1,204 ft., which gives a static pressure of 522 pounds per sq. in. The steel pipe is wedge-jointed to the stave pipe, and here a 4-in. standpipe rises 50 ft. into the air.

In laying the pipeline work was begun from both ends simultaneously, and as each length of pipe was laid in the trench it was immediately covered, with the exception of the bell joints, which were left open for inspection, but covered later. At six different points along the pipeline where material changes occur in the slope of the ground, the pipe was provided with automatic relief valves. As originally installed, these were enclosed by wooden housings, in

FIG. 5.—WHERE STAVE PIPE DROPS INTO CANYON.

order to keep the valves from freezing, but winter before last the housings proved to be ineffective in this regard, and the difficulty was temporarily overcome by placing eight 10-cp incandescent lamps in each valve housing, the 48 lamps so used being connected in series

across the 500-volt generator circuit, which is carried some distance up the pipeline. Now, however, the valves have been protected against freezing by the use of sawdust walls in the housings. At the power house the pipeline terminates in a 30-in. lap-welded receiver with cast-steel fittings.

Of all the devices which have been installed in power plants in California for removing leaves, twigs and rubbish generally from flumes and penstocks, so that the water entering the pipeline may be free from anything that might obstruct even the smallest nozzle, there is none to the writer's mind that compares with the revolving strainer in use at the penstock for the exciter pipeline at Volta. Water for this important service is taken from Mill Creek by means of a 2,400-ft. ditch. This automatic strainer consists of two short flumes in combination with a revolving screen of cylindrical form, clear into the open end of which is carried, axially through the cylinder, the lower flume, which leads to the penstock a few feet away. Water from the ditch enters through the upper flume, which empties into the lower flume through the top of the revolving screen. It is thus simply a case of an upper flume emptying into a lower one, built transverse to it, through the interposition of a revolving-cylindrical screen that is placed barrel-like about the head of the lower flume. A 54-in. undershot paddlewheel with eight dish-shaped buckets runs in the upper flume some 10 ft. above its end, and gives

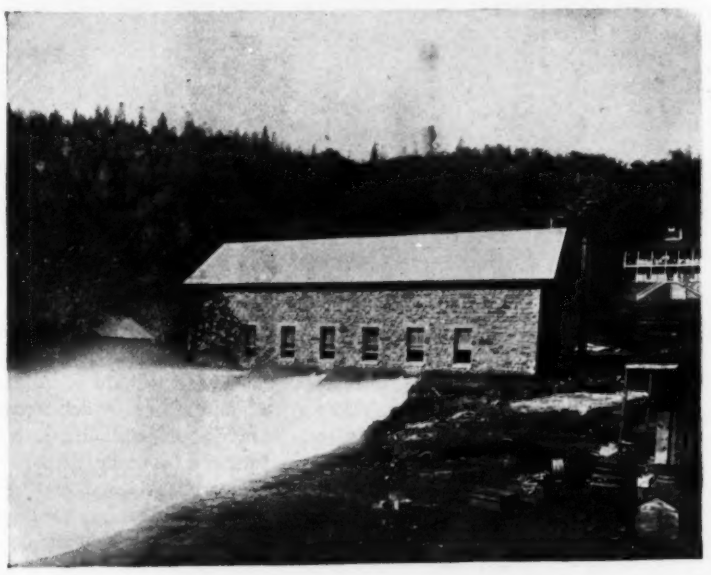


FIG. 6.—VOLTA POWER HOUSE.

motion to the revolving screen through a sprocket chain and wheels. The velocity of the water in this upper flume is intentionally high in order to give the necessary power to the wheel and to render positive the clearing of it from floating or entrained materials of whatever size. The latter, when poured on top of the cylindrical screen, is at once rolled off to the dump pile below, while the water drops through the ½-in. mesh of the screen and is picked up by the lower flume within it. In construction, the cylindrical screen is 4.5 x 5.5 ft. in size, placed horizontally in its longest dimension. Its head is a single piece of cast iron, in the center of which is bolted a flange carrying the shaft that supports its end of the screen as well as the driven sprocket wheel. The other or open end of the screen is supported by a welded ring of wrought iron, the periphery of which runs on ball bearings in grooves. The screen is driven at a speed of about 20 r.p.m.

Prior to the erection of this device, now over eighteen months ago, the leaves and debris which came down the exciter ditch and into the penstock were the cause of never-ending trouble and expense. In fact, during autumn months, when leaves were falling, the grizzly then placed at the penstock required constant attendance day and night. The cost of this attendance was previously as high as $300 per year, which is more than three times the cost of the entire mechanism, but now an occasional oiling and the raking away of the debris at the dump is all that prevents absolute automaticity in its operation.

Thus is water supplied separately to each character of hydraulically-operated machine in the power house; that is to say, the main pipeline supplies water solely for the operation of the main water wheels, the exciter wheels are driven by a separate pipeline taking water from Mill Creek, and finally the water pressure utilized in the Lombard governors is derived also from Mill Creek, albeit indirectly, by taking water from the spillway of the exciter penstock. The latter is then stored in a wooden tank, 5 x 8 x 16 ft. in size, whence it is carried to the power house through 900 ft. of 6-in pipe, reaching there under a static head of 160 ft. The necessity for such independent sources of water supply is of paramount importance in any installation wherein continuity of service and absolute perfection of regulation are desired.

The power house, a view of which is given in Fig. 6, is a thoroughly substantial structure of broken volcanic rock in large sizes, laid in cement, and measuring 82 ft. in length by 43 ft. in width. Its roof is of corrugated iron supported on steel trusses. It is ceiled with horizontally-laid corrugated iron painted white. Its walls within are finished in whitened mortar, and its floors are of concrete. A ten-ton chain-block crane traverses the length of the generator room. It is large, well lighted and ventilated, and in summer the heat of the sun is tempered by window awnings. A stone firewall divides the building into two sections, viz.: the generator section and the transformer section, the widths of which are 28 ft. and 15 ft., respectively, by a common length of 200 ft. Owing to the allotment of space at each end of the transformer section to static arresters, it became necessary to add more space thereto, which was done by the erection of a stone annex measuring 8 x 18 ft. in size, with two partitions, and wherein are housed three of the nine 600-kw transformers constituting the step-up equipment. Sliding doors give egress from the transformer section to a paved courtyard wherein transformers may be moved about and inspected or repaired, while in a far corner of the court is a spare 600-kw transformer housed in with corrugated iron and filled with oil ready for instant use.

The generating equipment of the station consists in the main of three 750-kw, three-phase, 60-cycle, 500-volt, revolving-armature Westinghouse generators, each of which is coupled to a 1,500-hp Pelton water wheel, so arranged that by means of flexible couplings and extended shafts the wheel and generator units are interchangeable in a measure. The advantage embodied in such an arrangement is obvious, since with the type of coupling used but little time is required to change over from one wheel or generator to another.

From the receiver, water is carried through three lap-welded steel pipes, situated under the main station floor, to the main units, each pipe being fitted with two heavy gate valves; one, an emergency valve, near the receiver, and the other a special Pelton gate valve, near the water wheel. In order that the latter may easily be operated under the heavy pressure involved—106,000 pounds on its disc—it is fitted with double-thrust steel roller bearings and a worm gearing, all being of special Pelton design, with bronze seat and unit. The water is led to the wheels through a heavy ball and socket deflecting nozzle that operates on forged-steel trunnion bolts in oil-packed gun metal bushings. The nozzle is provided with an assortment of interchangeable tips, used for the purpose of regulating the maximum output of the generator to correspond with the load.

Type F Lombard governors—one for each generator unit—control the deflecting nozzles. The latter are 12 in. in diameter and involve a pressure of 60,000 pounds on each nozzle ball joint, this pressure being taken up by two forged-steel fulcrum bolts. The joint between the pivot flange and the ball is packed with leather, to facilitate the easy control of the nozzle with the least possible friction, and throughout a high factor of safety prevails, every piece being tested to 700 pounds per sq. in. Pelton buckets are used exclusively, each bucket being milled and drilled to gauge and driven on the disc wheel centers, where it is held in place by turned steel bolts that are driven in reamed holes. These bolts have a safety factor of twenty under the limit pressure. Each bucket is separately balanced on knife edges, and will safely withstand 800 r.p.m., or, when locked in position, it will withstand the blow of a 4-in. stream under a 1,200-ft. head. The wheel centers and buckets are made of the highest grade of cast steel obtainable and test strips run from the same heat show a tensile strength of over 70,000 pounds and an elastic limit of over 30,000 pounds per sq. in.

Each wheel center is carefully bored for a press fit on a 9-in. shaft and fitted in the shops with forged steel keys. The shafts are of the best grade of hammered steel, 10′ 10″ in length and of proportions and safety factor slightly in excess of the armature shafts. Each shaft is carried in ring oil bearings in large surfaces of special high-grade babbitt metal, and the bearings are provided with a machined spherical surface, convex and concentric to the shaft on the babbitted barrel and concave on the pedestal, so that they are self-

aligning with the shaft and, therefore, have the same pressure throughout their lengths. Each bearing has a large hollow shell, which is full of oil, the depth of which is registered by a protected sight gauge glass. The oil is automatically carried in large quantities to the top of the shaft by bronze oil rings, which rotate with the shaft, and are made with a registered parting joint. The bearings are, in brief, similar in all respects to those of large, high-grade electrical machinery, and are mounted on a large cast-iron bedplate, which also supports the upper and lower housings. These housings are also of cast iron, for the purpose of deadening the noise, and on their switchboard sides indicating tachometers are provided. The floor spaces around the gate valves, pipe connections and over the tailraces are covered with cast-iron grilled floor plates, setting in cast-iron frames, which allow easy access to all the hydraulic apparatus.

The exciter units, which are two in number, and are counterparts, are of the well-known Theberath combination type, more fully described in conjunction with the Kilarc power plant, which follows later. Each consists of an 18-in. Pelton wheel, a 45-kw, 125-volt, Westinghouse multipolar, direct-current generator, and a 50-hp type C Westinghouse, 500-volt, three-phase induction motor, all coupled in line in direct connection and running at a speed of 975 r.p.m. The water for this wheel is controlled by means of a deflecting nozzle, with hand wheel and screw mechanism, which operates vertically in deflecting the nozzle. The remaining hydraulic feature of interest about the plant consists in the use of strainers with duplicate screens and valves, which are connected in the respective pipes for the governors so as effectively to clean all water that passes to them. The screens are so arranged that either set may be removed for cleaning while the other one remains in use.

The cables from the generator terminals pass in ducts directly to the switchboard, which is of white marble. This is in four panels, the first of which (beginning the enumeration from the left) is the exciter panel, the remaining three panels being for the respective generators. A fifth panel is provided near one of the exciter combination sets for controlling the induction motor of either set, and this motor panel carries an auto-converter and the necessary switches and fuses under an arrangement which permits starting either motor from the panel.

Reverting to the exciter panel, it carries a 150-volt Westinghouse voltmeter, two 300-amp. ammeters, a pilot lamp and two exciter

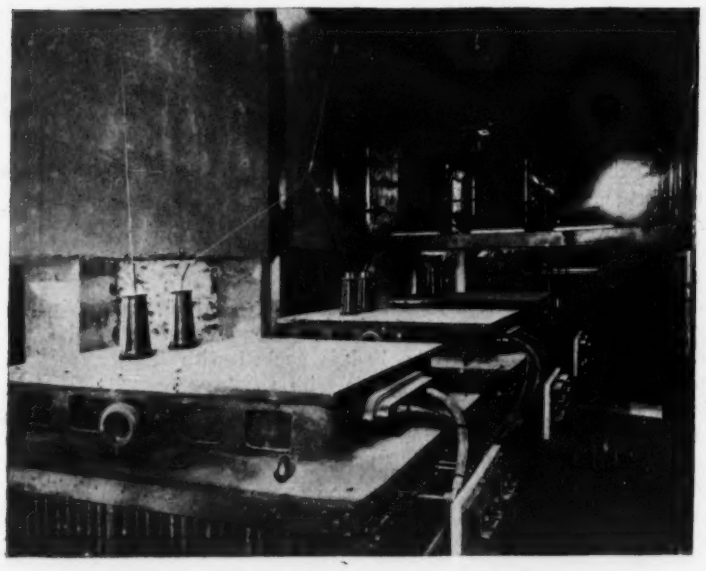


FIG. 7.—TRANSFORMER ROOM, VOLTA POWER HOUSE.

field rheostats, a triple-pole, single-throw paralleling switch, a voltmeter plug and two triple-pole, double-throw knife switches, by means of which either exciter may be thrown on to either exciter bus. At the left of this panel a bracket carries a Bristol recording voltmeter, and another carries a 6-in. vibrating gong used for indicating telephone calls. The generator panels are alike and they carry, respectively, three 1,500-amp. ammeters, a 750-volt voltmeter, with phasing plug, an 800-kw wattmeter permanently connected in phase C, and another similar wattmeter which may be plugged into either phase *A* or phase *B*, a field switch of the single-pole, single-throw knife variety, and two triple-pole, single-throw knife switches by means of which the generator may be thrown on to either set of transformer buses. In addition each generator panel carries two bracket lamps, a synchronizing lamp and a synchronizing plug switch —synchronism being effected, of course, on the maximum illumination of the lamp.

Concrete subways carry the 500-volt cables from the switchboard to the respective transformers, which are nine in number, each having a capacity of 600 kw. They are of the oil-insulated and air-cooled Westinghouse type, and each transformer is protected by a double-

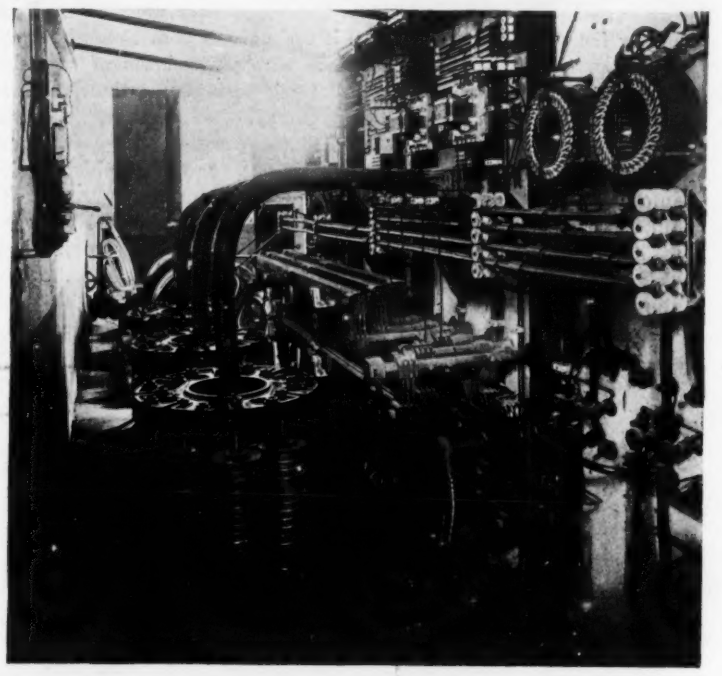


FIG. 8.—BACK OF SWITCHBOARD, VOLTA POWER HOUSE.

pole fuse specially mounted on its case. These transformers are in two banks: No. 1 bank contains six transformers, which are permanently connected in parallel on line No. 1, while bank No. 2 consists of the remaining three transformers, a spare transformer being stored in the court as stated heretofore. In each end of the transformer section is a bank of three static arresters, partitioned off from the transformers by means of a 6-ft. concrete wall.

From the transformers two high-tension circuits pass directly to the respective lines through the intervention of M. T. switches, so arranged as to allow either bank of transformers to be connected to either line, exit being made through glass-enclosed ports in the ends of the building section.

A further feature of interest in the Volta power house consists of the use of three 5-in. vibrating bells, two of which indicate excessive temperature in the transformer cases, as noted, by thermostats thereon, and the third is a low water alarm from the exciter penstock.

Damage to the Electra Plant.

At midnight, August 12, a serious break occurred in the pipeline of the Electra plant of the Standard Electric Company, in California, causing considerable damage to the power house and equipment. The ordinary pressure under which the five dynamos have been operated is 1,400 ft. This is over 250 ft. less pressure than a full head. The full head was turned on for the first time early in the morning of August 12. The stoppage of street car service in Oakland and San Jose at midnight and the consequent shutting down of one or more of the generators put an extra strain upon the pipeline, part of which is composed of cast iron pipe ¾ of an inch in thickness. The strain upon this pipe caused a piece of it 8 ft. long and 13 in. wide to blow out. Five thousand inches of water was turned loose, tearing down the hillside for 1,400 ft., striking the power house at the bottom. The wooden pipe above the break collapsed from the vacuum when the water was turned off from the head of the line. The power house was covered two or three feet deep with mud and debris. The galvanized-iron siding of the power house was stove in where the force of the water struck it, and the dynamos were covered up in the mud sluices.

Reception and Entertainment of the Electrical Engineers from Abroad.

The English electrical engineers and their friends who landed at Boston last Friday morning, September 2, had a pleasant surprise awaiting them. They confessed that there had been nothing to mar the enjoyment of an exceptionally pleasant trip save forebodings of wearisome and exasperating hours of delay in getting their belongings through the customs. But the Boston Reception Committee, represented by Messrs. C. H. Hodgkinson and George H. Lyman, and accompanied by Mr. G. C. Lloyd, secretary of the English Institution of Electrical Engineers, met them at Quarantine, and in 45 minutes after landing on the pier the whole of the party, their "tariff" troubles over, were on their way to the Hotel Vendome.

As the White Star steamship *Republic*, on which they were passengers, was well ahead of her schedule time, there were a few hours to dispose of not contemplated in the official programme. Of these Mr. C. L. Edgar, chairman of the Local Reception Committee of the American Institute of Electrical Engineers, promptly availed himself to give the foreigners what was to most of them an entirely new experience, viz.: a visit to the baseball ground, where a swift game was being played by the crack teams, Boston and Cleveland. Soon after the visitors returned to the Vendome they were joined by the Italian party, who, with Mr. John W. Lieb, Jr., and other representatives of the Institute, had come on by the Fall River boat from New York. While at Fall River the party visited one of the cotton mills, through the courtesy of Mr. A. B. Lisle, leaving at 9 o'clock Friday morning for a trip on Narragansett Bay to Newport, where carriages were taken for a trip around the neighborhood by way of Ocean Drive.

In the evening a reception was given by the Reception Committee at the Vendome. This constituted the beginning of the regular circular tour organized by the American Institute of Electrical Engineers. The reception was followed by an informal supper. Mr. Edgar, after welcoming the visitors in behalf of the Institute, introduced Governor Bates, who, in the course of his address, said that Massachusetts, as the birthplace of Benjamin Franklin and Morse, and the home of Bell, was particularly fortunate in being the first to welcome in its leading city the scientists and electricians from England and Italy. President R. Kaye Gray, of the British Institution of Electrical Engineers; Prof. Moisè Ascoli, of the Associazione Elettrotecnica Italiana, and Mr. John W. Lieb, Jr., chairman of the American Reception Committee of the International Congress, were introduced in turn, and for their respective bodies expressed thanks for their warm reception in Boston. Mr. Gray was enthusiastic in his praise of the Boston parks, the equal of which, he said, were not to be found in England.

On Saturday the visitors were taken in automobiles to various points of interest in the city. The first visit was made via Summer Street Extension to South Boston, to the new turbine power station of the Edison Electric Illuminating Company, of Boston. Here twenty guides, under the direction of Mr. Sidney Hosmer, construction engineer of the company, were in readiness to conduct the party over the station. The headquarters of the American Telephone & Telegraph Company and the New England Telephone & Telegraph Company, at 125 Milk Street, were next visited. The visitors were received by a committee consisting of President F. P. Fish, Vice-President Sherwin and Messrs. Houston, general manager; Wright, superintendent, and Wales, chief engineer, and were shown over the plant. A delightful ride was then taken through the park system, around Jamaica Pond, and past the Country Club to Soldiers' Field, a short stop being made to examine the Stadium. The route then led to Pierce Hall, where the party was met by Dr. A. E. Kennelly and other representatives of Harvard University. The Museum, Pierce Hall, Jefferson Physical Laboratory, Memorial Hall, Germanic Museum and Harvard Union were visited. At the Union an informal reception was given, Dr. Henry P. Wolcott, representing the corporation of Harvard College, and lunch was served, with the much-appreciated accompaniment of music by members of the Boston Symphony Orchestra. To Dr. Wolcott's address of welcome responses were made by Presidents Ascoli and Gray.

At 3 o'clock, by courtesy of the Boston Elevated Railway Company, special cars were taken for the return trip over Harvard Bridge, to Copley Square, and the visitors were received at Rogers Building, on Boylston Street, by Prof. H. E. Clifford Lawes and others, representing the Massachusetts Institute of Technology, and shown through the various buildings of the institution.

The ladies of the party, and those not desiring to visit the power station and the telephone headquarters, were taken in automobiles through the city and out to the park system, joining the main party at Harvard College. The visitors took the afternoon train to Fall River, arriving by the Fall River boat in New York early the next morning.

The united party landed in New York very early on Sunday morning, the boat making an unusually expeditious trip. It was met by the New York local reception committee with automobiles furnished by the New York Transportation Company, and by three 5-ton electric trucks loaned by the New York Edison Company. Such dispatch was made that the entire party and all its baggage had left the wharf by 7.30 a.m. The visitors went chiefly to three hotels—the Waldorf, Fifth Avenue and the Park Avenue—the first being headquarters of the British delegation and the last the headquarters of the Italian. Sunday morning was given up to rest, church-going, etc., and at 2 p.m. the Starin steamboat *Richmond* was taken at the foot of West Thirty-fifth Street for the Hudson River excursion given to the Institute and its visitors by J. G. White, Esq., a member of the New York committee. Over 600 persons took advantage of this delightful hospitality, the day being ideal in every respect of weather and sunshine, and the hour being convenient for everybody. The boat had no sooner started up the Hudson than a hearty luncheon was served by Mazzetti, and when things had been cleared away cigars and liquid refreshments were available until such time as the boat, retracing her course, had gone down the lower bay to Coney Island and had reached Dreamland at just such a moment in the dusk as permitted the visitors to see the outburst of brilliant electrical illuminations at that seaside resort. The boat docked at about 7 p.m. and left at 10, tickets being furnished by Mr. White for entrance to Dreamland and for three or four of the most interesting spectacles of that wonderful pleasure ground. It was a beautiful, clear and crisp evening, and it was with the greatest difficulty that members of the party were induced to return to New York. The excursion was handled on behalf of Mr. White by a special committee, of which Mr. P. G. Gossler was chairman, assisted by Mr. J. M. Wakeman, on behalf of the committee, as well as by Messrs. Collette, Reed, Young, Lardner and others of the J. G. White Company. A large number of the local reception committee were also on board to assist in managing this big excursion, which went off with the utmost smoothness and dispatch.

On Monday morning, Labor Day, rendezvous was made at the steps of the City Hall, at 9.15 a.m., to which point all the foreign visitors were brought by the local committee in automobiles from their hotels. At 9.30 a.m. a party of nearly 700 was received by Messrs. L. B. Stillwell and H. G. Stott, on behalf of the Interborough Rapid Transit Company, with a corps of assistants, at the City Hall Station, where a pioneer train of eight cars was promptly loaded, each carrying 80 passengers, some cars being of the all-metal construction. A journey was made with varying speeds up to the Columbus Circle Station at Fifty-ninth Street, ample opportunity being afforded to note the construction of the track, cars, signals and stations.

The party then walked across West Fifty-ninth Street to the Hudson River, and went through the new power house of the Interborough Company at that point. This plant, now nearing completion, and partly in operation, was noted with much interest by all. At the New York Central pier adjoining the party boarded the swift steamboat *Nassau*, of the Long Island Railway Company, which was accompanied by the cable boat of the Western Union Company, in charge of Messrs. Frank Kitton and W. Finn. As the flotilla proceeded up the North River, the New York City Fire Department, by courtesy of Chief Croker, gave a magnificent exhibition of fighting the flames from the river front by one of its largest fire boats, which played water with large and small streams and in all manner of combinations, with such efficiency and rapidity of change that the whole party of spectators not only applauded with their hands, but burst into cheers. This performance took place just below Grant's Tomb, whereupon the boats proceeded around into the Ship Canal at Spuyten Duyvil, thus attaining the Harlem River and reaching the second power house on the programme, namely, that of the New York City Railway, at Kingsbridge. Here they were received by Mr. M. G. Starrett, chief engineer of the company. While the men were ashore at this point, luncheon was served to the ladies on the *Nassau*, and between Kingsbridge and the Manhattan Elevated power house, at Seventy-third Street, luncheon was served to the men, while the boat was en route.

It had been intended to show the visitors the Metropolitan power house of the New York City Railway, at Ninety-sixth Street, but

the interest manifested in the other plants compelled the cutting out of this part of the programme, so as not to lose time on the schedule. After a thorough inspection of the Manhattan plant, the flotilla moved on to the East Thirty-eighth Street Station of the New York Edison Company, where Mr. J. W. Lieb, Jr., and a staff were in attendance to show them through that superbly equipped lighting and power plant, which was, moreover, particularly interesting because it exhibited in operation one of the large new Curtis steam turbine units. The party disbanded at this point at about 4 p.m. During the day Mr. F. A. Pattison, as chairman of the Ladies' Auxiliary Committee, took a party of visiting ladies who did not participate in the power house trip, up to Claremont and Grant's Tomb in automobiles, lunching at Claremont.

At this point the Institute intervened actively for the first time, and with the assistance and co-operation of the New York local reception committee, gave a reception and banquet at the Waldorf-Astoria in the evening. This affair was attended by about 300 persons, including a great many ladies, and was one of the most brilliant and successful affairs of the kind held under Institute auspices. The banquet was preceded by a reception given in the Astor Gallery, and dinner was served about 7.15 p.m. The chief guests of the evening were seated at a raised table across the end of the Grand Ballroom, and backed by draperies of the American, English, Italian and other national colors, which ran thence around the entire hall, interspersed with banks of electric lights. Mr. Bion J. Arnold, president of the Institute, presided, having on his right Mr. R. Kaye Gray, president of the Institution of Electrical Engineers of Great Britain, and on his left Prof. M. Ascoli, president of the Associazione Elettrotecnica Italiana. These gentlemen were supported on either hand by Mr. Fornes, president of the Board of Aldermen, representing the city; Prof. Elihu Thomson, chairman of the Organization Committee of the International Electrical Congress; Wilhelm Von Siemens, of Berlin; Baron Von Ferstel, delegate of Austro-Hungary; Frank J. Sprague, president New York Electrical Society; Prof. John Perry, past-president of the British Society; C. W. Hunt, secretary of the American Society of Civil Engineers; C. A. Coffin, president General Electric Company; C. F. Scott, past-president of the Institute; Robert Hammond, honorary treasurer of the English Society; Col. R. E. B. Crompton past-president, Dr. R. T. Glazebrook member of council, and G. C. Lloyd secretary of the same body; Prof. L. Lombardi, vice-president of the Italian Society; M. Otamendi and A. Gonzalez y Echarte, representing the Spanish Government; John W. Lieb, Jr., chairman General Reception Committee of A. I. E. E.; Prof. F. B. Crocker, of Columbia University; T. C. Martin, chairman New York Reception Committee, and R. W. Pope, secretary A. I. E. E.

The speaking was necessarily very brief, as all who were going on the circular tour had to be up bright and early next morning. Mr. Arnold made a brief address of welcome on behalf of the Institute and Mr. Fornes on behalf of the city. These welcomes were responded to on behalf of their respective societies by Presidents Gray and Ascoli, and by Mr. Von Siemens, who spoke for electrical engineering in Europe. Prof. Elihu Thomson then delivered a pretty little address of welcome on behalf of the Congress, and this was responded to very neatly and humorously by Prof. Perry. Mr. C. A. Coffin then welcomed the visitors on behalf of the electrical industries of America, and once more proved his right to be included in the list of American electrical orators as well as a leader of the industry. He was followed by Mr. John W. Lieb, Jr., who gave an admirable finishing touch to the whole affair by the warmth and earnestness of his welcome on behalf of the general and local reception committees. During the evening various national airs were played, which afforded an opportunity for frequent applause and demonstration. The ballroom has rarely looked prettier than it did with its lavish decorations of flags and flowers, and Mr. Calvin W. Rice, chairman of the Dinner Committee, with his co-laborers, Messrs. C. A. Terry, G. F. Sever, L. J. Magee, T. C. Martin and C. Townley, are to be congratulated on the smoothness and success of the dinner. A very artistic menu was prepared, of a suggestive and interesting character. It was in broadsheet form, showing the Institute badge as a Franklin kite in dark blue on an azure sky across which a long flash of lightning played. The tail to the kite was made up of flags of various nations in colors, with the star-spangled banner at the end of the string, while from the kite ran down a string to an old-fashioned veritable key, such as Franklin might have used in his experiments. Inside, printed on a separate sheet, was an exquisite wash color drawing printed in Niagara green, showing an Indian smoking a pipe of peace, seated on the bank of the great waterfall, and watching take shape from its rising clouds of mist all the newest and most hopeful developments of the great electrical arts. A further souvenir of the occasion consisted in dainty little copper-coated plaster casts of a well-known bust of Benjamin Franklin, mounted on a pedestal, which served as a box for the sorbet. The guests seemed very appreciative of these souvenirs of American hospitality.

On Tuesday morning, September 6, at 9 o'clock sharp, the special tour organized by the Institute, with the aid of Raymond & Whitcomb, started from the Grand Central Depot with about 160 passengers on board and having hitched to it a special car provided by President Coffin of the General Electric Company for visitors going as far as Schenectady to participate in the reception at the great works there. It was an exquisite morning up the Hudson and the river never looked more beautiful. The trip was made smoothly and the works at Schenectady were reached about 1 p.m. Lunch was immediately served in the gallery of one of the new shops just put up in connection with the turbine work, it being apparently the practice of the General Electric Company to construct a big new shop every time some large party has to be entertained. Several big circular tables were set out with palms and flowers in the middle, and an excellent meal was served in metropolitan style, after which the men spent two or three hours examining the works, while the ladies were taken off in automobiles to see the golf links, and to get afternoon tea, etc. The visitors were then given a trolley trip over the Schenectady Railway to Ballston, having an opportunity to witness the new alternating-current-direct-current street railway system of the General Electric Company. At Ballston the party found its regular train awaiting it. The reception committee at Schenectady comprised all the well-known leaders of the company staff, including Mr. Coffin, Messrs. Steinmetz, Lovejoy, Emmons, Rohrer, Hamill, Kruesi, Peck, M. P. Rice, Mullin and Clark. Mrs. Coffin was at the head of the ladies' reception committee. Among the New York reception committee who escorted the party to Schenectady, and there turned them over to the next local organization for their entertainment, were Messrs. Martin, Wheeler, Crocker, Muralt, Curtis, C. W. Price and Dunn. The special train had been very well organized and the method of handling baggage and taking care of their comfort on board seemed to have gained the hearty approval of the visitors. The cars are chiefly of the boudoir type, so that the greatest measure of privacy and coziness is secured, including also special arrangements for café service, quick baggage supply, etc., Mr. Ralph W. Pope, secretary, having with him virtually a branch office.

While the train was organized primarily for the benefit of the visitors from abroad, a number of the leading members of the Institute have associated themselves with the affair in order to do what they can to make the thing a success, so that the party as it goes from point to point will include around the circuit Mr. and Mrs. F. J. Sprague, Mr. and Mrs. J. W. Lieb, Jr., Mr. and Mrs. H. Ward Leonard, Mr. and Mrs. P. Torchio, Mr. C. F. Scott, Mr. B. J. Arnold, Commissioner Barker, of the Water, Gas and Electricity Commission; Mr. and Mrs. C. W. Rice, Mr. and Mrs. E. H. Mullin, Mr. George Bullock, president of the Bullock Company, and others. The party is escorted also from point to point by special relays, Mr. J. M. Wakeman and William Maver, Jr., of New York, for example, accompanying it all the way to Montreal to assist in making the connections smoothly and swiftly. In fact, every step and measure that could be thought of in advance has been taken to insure success and promote the happiness and comfort of the visitors from abroad. Mr. Mullin as chairman of the transportation committee was not less efficient than indefatigable.

The party reached Montreal in good time on Wednesday morning, September 7. At an early hour a boat was taken for the Lachine Rapids, lunch as well as the boat being provided by the city. They were received by Alderman Sadler, on behalf of the Mayor, and Prof. R. B. Owens, the chairman of the local reception committee. The entertainment for the day included lunch at the main sub-station of the Montreal Light, Heat & Power Company, where Mr. W. McLea Walbank received. The health of King Edward was drunk with enthusiasm, and remarks were made by Messrs. Gray, Ascoli and Arnold. This was followed by a reception at McGill University from 4.30 to 6 p.m. and a garden party in the evening at the Forest and Stream Club. The programme for the next day included a visit to Shawinigan Falls, with alternative trips of less distance and fatigue.

Delegates to the International Electrical Congress, St. Louis, 1904.

MR. JOHN HESKETH.

Mr. John Hesketh, delegate from the Australian Colonies, was born in 1868, at Lytham, Lancashire, England. Entering the British Postal Service in 1881 as operator at Lytham, he was transferred to Newcastle-on-Tyne in 1883, and after serving there in various capacities in the telegraph and telephone branches, was transferred to the engineering branch under Mr. A. W. Heaviside, superintending engineer of that district. During part of this period Mr. Hesketh attended lectures at the Durham College of Science and the Science and Art Schools of Newcastle. In 1889 he went into the service of the Newcastle-on-Tyne Electric Supply Company, with which company he remained until appointed as Borough Electrical Engineer of Blackpool in 1892. Here he installed the system of municipal lighting and had charge of the electric railway service. In 1896 he was appointed Electrical Engineer to the Government of Queensland, where he had charge of the engineering matters connected with the telegraph and telephone services under the control of the Government, and also advised on matters relating to the control by the Government of electric lighting and traction undertakings. In this position he continues at the present time. Mr. Hesketh will present a paper before the Congress giving an account of the damage done in the Australian Colonies by an insect which perforates the lead shield of cables.

PROF. CHARLES ZIPERNOWSKY.

Prof. Charles Zipernowsky, delegate from Austria-Hungary, was born in Vienna, in 1853, and received his early education at Budapest, where has was graduated from the Gymnasium. He subsequently studied chemistry, and in 1872 entered the Royal Polytechnicum, where he took up the study of mechanical engineering, and in 1877 was given the degree of Engineer. During the last year of his studentship he constructed electrical apparatus, and in 1878 was engaged by the firm of Ganz & Company, Budapest, in whose works he made the same year the first direct-current machine manufactured in Hungary, and the first alternating-current generator, the type then constructed being still manufactured by Ganz & Co. Prof. Zipernowsky remained with the Ganz Company until 1893, when he was appointed Professor of Electrotechnical Science in the Royal Hungarian Polytechnic Institute in Budapest, which position he now occupies. Prof. Zipernowsky has been one of the most fertile of electrical inventors, his work in this line being represented by a long series of patents dating from 1881 until recent years. These cover a polyphase generator dated in 1881, a self-exciting and self-regulating alternating-current dynamo, 1882; a generator producing direct, alternating and polyphase current of constant voltage or constant current, and numerous other machines and devices. Some of his most noted patents are on transformers, one of which dates from 1885. The rotary converter is represented by patents dating from 1884, a broad patent issued in 1890 being on the distribution system of alternating and continuous current by means of rotary converters and storage batteries. Other inventions of an early date are on various details and systems for interurban rapid transit electric railways, and of later date are patents on polyphase motors (1894), type-printing telegraphy (1895), electric heating furnace (1896). In some of these inventions Prof. Zipernowsky has worked in conjunction with Messrs. Déri and Blathy, and in some cases with both of these gentlemen.

PROF. CHARLES ZIPERNOWSKY.

PROF. JORGE NEWBERY.

Prof. Jorge Newbery, delegate from the Argentine Republic, was graduated from the Drexel Institute, Philadelphia, in 1895. In the following year he served as electrical engineer with the Compania Electricidad y Traccion del Rio de la Plata. In 1897 he was appointed Electrical Engineer of the first order in the Argentine Navy, and in 1898 he was promoted to Chief Electrical Engineer of the Argentine Navy, and sent to Europe as special commissioner for the purpose of purchasing and superintending the construction of electrical apparatus for the navy and for the coast defences. In 1900 he was appointed general director and commissioner of the electric works and public lighting of the city of Buenos Aires, which office he now holds. Mr. Newbery is also Professor of Electrical Engineering in the Escuela Industrial de la Nacion, and has a large practice as a consulting electrical engineer. He is a member of the Argentine Scientific Association, under whose auspices he has published a series of articles in favor of the municipalization of the electric and gas lighting services in the city of Buenos Aires.

PROF. JORGE NEWBERY.

DR. SVANTE ARRHENIUS.

Dr. Svante Arrhenius, delegate from Sweden, was born February 19, 1859, near Upsala, Sweden. He was educated at the gymnasium and the universities of Upsala and Stockholm, and received the degree of Ph. D. from Upsala in 1884. He then studied a number of years with Ostwald, Boltzmann, Kohlrausch and Van't Hoff in Riga, Leipzig, Graz, Würzburg and Amsterdam. He was appointed a teacher of physics at the University of Stockholm in 1891 and Professor of General Physics at the same university in 1895, being elected rector in 1897. He first became widely known by proposing the electrolytic dissociation theory, and on the basis of this theory he developed, in conjunction with Ostwald, Van't Hoff, Nernst, Planck and others, the modern theory of solutions. Later on he applied the principles of physical chemistry to problems of cosmology, like the theory of auroras, etc., and more recently to questions of medicine and biology. He received last year the Nobel prize for chemistry. He is the author of a treatise on theoretical electrochemistry and has published a very great number of scientific papers in various languages—Swedish, German, English, French, Dutch and Russian. Prof. Arrhenius will present a paper on "The Relation Between the Sun's Rays and Electromagnetic disturbances on the earth.

DR. SVANTE ARRHENIUS.

PROF. MOISÈ ASCOLI.

Prof. Moise Ascoli, delegate from Italy, was born in Goritz, Italian Austria, November 30, 1857, and is a son of the renowned philologist, Prof. Grazzadio Ascoli, of the Faculty of Letters in the Academy of Sciences and Letters, of Milan, Italy. Prof. Ascoli obtained his primary and high school education in Milan, Italy, graduating from the University of Pavia with the degree of Ph.D. He is now Professor of Applied Physics in the Polytechnic at Rome, Italy. He was vice-president of the Associazione Elettrotecnica Italiana for three years, and is now president of that body. Prof. Ascoli comes to St. Louis as official delegate of the Ministry of Posts and Telegraphs to the official Chamber of Delegates of the Congress, and is also one of the representatives of his society as a co-operating body in the Inter-

PROF. MOISÈ ASCOLI.

national Electrical Congress. Prof. Ascoli has done important work in the physical sciences, including researches on the tensile strength of iron at different temperatures, on the magnetic properties of iron, steel and other metals, and other researches in magnetism. Prof. Ascoli will present a paper before the Congress entitled "Electromagnetic Units."

PROF. LUIGI LOMBARDI.

Prof. Luigi Lombardi, delegate from Italy, was born in Dronero (Cuneo) in 1867 and received the degree of Civil Engineer from the Royal School of Application of Turin in 1890. Having obtained, through competitive examination, the scholarship for the Advancement of Mechanics, founded by Signor Gori Zeroni, and awarded periodically by the Societa di Esecutori Pie Disposizioni of Sienna, which carries an honorarium of 300 francs a month, Prof. Lombardi spent the six years of the term of the scholarship in the study of electrotechnics under the late Prof. Ferraris at Turin and at the Polytechnic of Zurich under Prof. H. J. Weber. In 1895 he was awarded at the latter school the degree of Ph.D. and became an assistant to Prof. Weber in the Physical Institute of the Polytechnic School. He also served as Privat Docent in electrotechnics. Upon the death of Prof. Ferraris in 1897, Prof. Lombardi was successful in a competition for the chair of Technical Physics at the R. Museo Industriala of Turin. In 1900, as the result of an open competition, he was appointed Professor of Physics and Electrotechnics at the Royal School of Application at Naples, which institute is about to be transformed into a Polytechnic. Prof. Lombardi, besides representing at the Congress the Ministry of Public Instruction of the Italian Government, will also represent the Associazione Electrotecnica Italiana, of which he is vice-president. He attended in 1893 the International Electrical Congress at Chicago, where he first met the late Prof. Ferraris. The electrical work of Prof. Lombardi has been principally in the field of electrostatic polarization and demagnetism, and with relation to the rotary transformer, the Ferraris-Arno principle, condensers and osmium lamps. At St. Louis he will present a paper entitled "Stroboscopic Observations of the Arc."

PROF. LUIGI LOMBARDI.

AMATORE MAFFEZZINI.

Cav. Ing. Amatore Maffezzini, Chief Engineer of Bridges and Highways, Delegate from Italy, was born in Sundrio, Italy, January 19, 1854. He pursued his primary education at Sundrio, and was graduated from the Royal Polytechnic in Milan with the degree of Civil Engineer. He also took a special course in electricity under the late Prof. Ferraris. Mr. Maffezzini is at present director of important public works on the Island of Sicily, under the Italian Government, including works on irrigation, reclamation and construction of highways. Mr. Maffezzini is accredited to the Congress as official delegate of the Ministry of Public Works of the Italian Government. He is a member of the Roman section of the Associazione Elettrotecnica Italiana. Mr. Maffezzini has made important reports on the application of electricity to canal traction at Charleroi, Belgium, and many official reports on public works in Sicily.

A. MAFFEZZINI.

SEÑOR ANTONIO GONZALEZ Y ECHARTE.

Señor Antonio Gonzalez y Echarte was graduated in 1889 from the School of Madrid with the degree of Civil Engineer. The following eight years he was engaged as State Engineer on work in the Departments of Cuidad Real, Guadalajara and Malaga. In 1897 he was appointed to the Official Council of Public Works at Madrid, and the following year became Engineering Director of the La Hullera de Torrelapaja Railroad Company. In 1899 Señor Gonzalez began the development of a transmission plant to transmit electrical power to Madrid from Colmenar, utilizing a fall of 100 meters in Manzanaves River, of which he was owner. At the same time and during the following years he was engaged on a transmission plant at Algar. Upon the successful termination of work on these plants he assumed direction as consulting engineer of the Mengemer Company in the development of important transmission plants at Almeria and Guadalimar.

A. GONZALEZ.

SENOR MIGUEL OTAMENDI.

Señor Miguel Otamendi, delegate from Spain, was graduated in 1898 as a civil engineer from the School of Madrid, being at the head of his class and receiving a diplome d'honneur from the Government. He then took a course in the Electrotechnical Institute at Liege under Prof. Eric Gérard, and in 1900 received the degree of Electrical Engineer. During 1901 he was on the staff of the Water Works Board of Madrid and then became engaged in work connected with the electrical transmission of power to Denia, and in electrical construction work at El Pardo, Madrid and elsewhere. In a national competition among civil engineers for the construction of a monumental bridge at Bilbao he won the first prize. At present Señor Otamendi is engaged on work connected with the transmission of power from Ohanès and from the mines of Linares. He has recently been appointed by the Spanish Government inspector of electrical installations in Madrid.

M. OTAMENDI.

PROF. H. S. CARHART.

Prof. Henry Smith Carhart, delegate from the United States, was born at Coeymans, near Albany, N. Y., in 1844. After teaching district school he prepared for college at the Hudson River Institute at Claverack, acting one year as a principal of a school during this period. He was admitted to Yale in 1865, but before taking up the course there went to the Wesleyan University, Middletown, Conn., whence he was graduated with the degree of B.A., having received first honors in several subjects and being valedictorian of his class. Later he received the degrees of A.M. and LL.D. from the same institution. After teaching two years in Cleveland, he took one year's post-graduate work at Yale, and later attended the Harvard Summer School of Chemistry. From 1872 to 1886 Prof. Carhart occupied successively the chairs of Civil Engineering and Physics at Northwestern University, and the latter year became Professor of Physics at the University of Michigan, which chair he now occupies. In 1881 he spent a year of study at Berlin under Helmholtz, and in 1900 was at the Reichanstalt some months engaged in experimental work. Prof. Carhart's name has been particularly connected with the development of standard cells. He brought the Clark cell to a high degree of perfection, but late investigations have led him to recommend the use in its place of the Weston cadmium cell. Prof. Carhart is the author of several standard textbook treatises and has contributed largely to scientific transactions and periodicals. He has been a vice-president of the American In-

PROF. H. S. CARHART.

stitute of Electrical Engineers, was a delegate from the United States to the International Electrical Congress of Chicago, 1893, and is at present president of the American Electrochemical Society. Prof. Carhart, together with Prof. G. W. Patterson, Jr., will present a paper on "The Absolute Value of the Electromotive Force of the Clark and Weston Cells." He will also present one, jointly with Dr. C. A. Hulett, on "The Preparation of Materials for Standard Cells and Their Construction."

DR. A. E. KENNELLY.

Dr. Arthur E. Kennelly was born at Bombay, India, December 17, 1861, and was educated at private schools and University College School, London. In 1876 he served as assistant secretary of the British Institution of Electrical Engineers, and the following year entered the service of the Eastern Telegraph Company. In 1880 he became assistant electrician on board the *John Pender* and a year later was promoted to the post of chief electrician. After serving in the same capacity on other cable vessels, he finally became senior electrician afloat of the above-mentioned company. In 1888 he resigned from the cable service to become electrician to Mr. Edison, then just commencing work on his new laboratory at Orange, N. J., and shortly after also acting as consulting electrician to the Edison General Electric Company and later to the General Electric Company. In 1894 he resigned from the above positions to enter into consulting engineering work with Prof. E. J. Houston, in which he engaged until 1901, when he was appointed to the chair of Electrical Engineering at Harvard University, which he now occupies. Dr. Kennelly's contributions to scientific and engineering literature cover a wide range of subjects, the earliest being on subjects connected with cable testing, and later on the development and popularization of alternating-current theory. They include also papers on magnetic theory, calculation of networks and the phenomena of capacity. A most valuable experimental work was on the determination of the heating by electric currents of conductors, the results of which were published in 1889, and served as the basis of the present underwriters' tables of heating limits. Dr. Kennelly is the author of several books and collaborated with Prof. Houston in the writing of a large number of elementary engineering works. He has served as president of the American Institute of Electrical Engineers, and was recently elected president of the Metric Society. Dr. Kennelly will contribute papers to Sections A, C and G of the Congress.

DR. A. E. KENNELLY.

PROF. HARRIS J. RYAN.

Prof. Harris J. Ryan, delegate from the United States, was born at Powell's Valley, Pa., January, 1866, and received his primary education at the public schools of Philadelphia and Baltimore. In 1880-1881 he attended the Baltimore City College; was a student at the Lebanon Valley College in 1881-1883, and graduated from Cornell University in 1887, after a four years' course in electrical engineering. After a year spent in electrical engineering work with two classmates, Mr. J. G. White and Prof. Dugald C. Jackson, he became an instructor at Cornell University in charge of the dynamo laboratory, and was appointed Professor of Electrical Engineering in charge of the department of that branch at Sibley College, in 1889. Prof. Ryan organized this department, and in 1895 was elected to full professorship at the age of 29. He has been vice-president of the American Institute of Electrical Engineers. Prof. Ryan has contributed a number of papers to the American Institute of Electrical Engineers and to other scientific publications. Among the most recent of the former is one on the "Use of the Cathode Ray as an Alternating Current Indicator," and another on the "Conductivity of the Atmosphere at High Pressures." He is the author of a textbook on Electrical Machinery, in which Profs. H. H. Norris and G. L. Hoxie collaborated. Among his more practical contributions to electrical engineering has been a type of single-phase commutator motor which is very largely used throughout the United States, and, in conjunction with Mr. M. E. Thompson, a method of armature compensation which has been applied to direct-current machinery and also to the alternating-current series motor. Prof. Ryan will present a paper on "The Design of Insulators."

PROF. H. J. RYAN.

DR. SAMUEL W. STRATTON.

Dr. Samuel W. Stratton, delegate from the United States, was graduated from the University of Illinois in 1884. From the latter year until 1892 he occupied successively the chairs of Assistant Professor of Physics and Professor of Physics and Electrical Engineering. In 1892 he became Assistant Professor of Physics in the University of Chicago, where he advanced to Associate Professor and finally Professor of Physics. While at Chicago University Prof. Stratton assisted Prof. Michelson in important research work, and devised apparati of several kinds for work demanding the highest precision. In 1899 and 1900, while engaged in some special work for the United States Office of Weights and Measures, Prof. Stratton became interested in the organization of a National Bureau of Standards along the lines of those conducted by the German and other European Governments. Through his advocacy the plan was taken up by the Secretary of the Treasury, and finally was realized by an Act of Congress creating the present National Bureau of Standards, of which Dr. Stratton was appointed director. During the Spanish-American War Dr. Stratton served as a volunteer lieutenant. He has received the degree of D.Eng. from the University of Illinois and D.Sc. from the University of Western Pennsylvania.

DR. S. W. STRATTON.

PROF. ELIHU THOMSON.

Prof. Elihu Thomson, delegate from the United States, was born at Manchester, England, in 1853, and was brought to the United States by his parents at the age of five years. After finishing the four years' course at the Central High School, of Philadelphia, he spent some months in an analytical laboratory and was then called to fill the position of assistant in the electrical department of the school, which he occupied until 1876, during the final year being also Professor of Chemistry in the Artisans' Night School. In 1876 Prof. Thomson was appointed to the chair of Chemistry at the Central High School, which position he filled until 1890, during this period also giving lectures and courses in electricity at the Franklin Institute. Prof. Thomson's first connection with electrical engineering was in 1877, when he served on a committee of the Franklin Institute to report on dynamo-electric machines. Upon his return from a visit to the Paris Exposition of 1878 the first of his long line of inventions began to appear. In 1880 the American Electric Company was organized, with works at New Britain, Conn., and the services of Prof. Thomson were secured as chief electrician to develop commercially the various lines of apparatus which he had devised. As the work of Prof. Thomson has extended to almost every field of electrical application, to enumerate would be almost to give a list of the more important commercial electrical apparatus of to-day. Of recent years his most important contributions have been in connection with wattmeters, and the invention of the alternating constant-current system of arc lighting. Prof. Thomson has also found time to devote to pure science, to which he has made many contributions. It has been remarked by one of the greatest of European savants that had Prof. Thomson devoted his life to pure science he would in this department have conquered a place second to none of the present generation. Prof. Thomson has served as president of the American Institute of Electrical Engineers and has been identified in an official capacity with many American scientific bodies.

PROF. ELIHU THOMSON.

DELEGATES FROM SOCIETIES AND ASSOCIATIONS.

DR. W. LASH MILLER.

Dr. W. Lash Miller, delegate of the Royal Society of Canada, was born at Galt, Canada, September 10, 1866. He matriculated at the University of Toronto in 1883 and was graduated therefrom in 1887 with the degree of B. A. In 1887-1890 he studied at Berlin, Gottingen and Münich in the chemical laboratories of Profs. Hofmann, V. Meyer and V. el c. Bayer. In 1890 he received the degree of Ph. D. at Münich and was elected a Fellow in Chemistry at the University of Toronto the following year, becoming at that time a demonstrator in chemistry at that institution. In 1882 he studied at Leipsic under Prof. Dr. Ostwald, and in 1900 was appointed Associate Professor of Physical Chemistry of the University of Toronto. In the same year he became a Fellow of the Royal Society of Canada, and in 1902 a member of the Washington Academy of Sciences. Dr. Miller has published a number of papers, contributed principally to German publications on chemistry and physical chemistry, and to the *Journal* of the American Chemical Association, *Journal* of Physical Chemistry and the *Transactions* of the Royal Society of Canada.

DR. HOWARD T. BARNES.

Dr. Howard T. Barnes, delegate of the Royal Society of Canada, was born at Woburn, Mass., in 1873, and graduated with honors from the McGill University in 1893, with the degree of B.Sc. Taking up the graduate work under Prof. H. L. Calander, F.R.S., he received the degree of M.Sc. in 1896. The Lord Aberdeen medal for research work was awarded to him in 1899 and in 1899-1900 he occupied the Joule studentship, awarded to him by the Royal Society of London for special research work. He received the degree of D.Sc. at McGill in 1900 and was elected a Fellow of the Royal Society of Canada in 1902. Dr. Barnes is now attached to the faculty of physics at McGill University. He has contributed a number of papers to scientific publications, principally dealing with his research work. One of the most important contributions to science by Dr. Barnes has been the determination of the mechanical equivalent of the unit of heat by electrical means, which furnished the subject of a communication to the Royal Society of London. Dr. Barnes will present before the Congress a paper treating of this subject.

DR. H. T. BARNES.

LIEUT.-COL. R. E. B. CROMPTON, C. B.

Lieut.-Col. Rookes Evelyn Bell Crompton, C.B., was born on May 31, 1845, and received his preliminary education at Elstree School. During the Crimean war he accompanied his father, Col. Crompton, to the Mediterranean, and served as a naval cadet on a warship. After finishing his education at Harrow in 1864 he entered the army, and while serving in India he was appointed to a position under the Indian Public Works Department. During this appointment he conducted some important experiments on the relative merits of narrow and wide-gauge railroads. Retiring from he army in 1876 he became a partner in a firm of engineers, and later, as engineer-in-chief of the Stanton Iron Works Company, introduced in 1877 the electric light for the illumination of the works. In 1878 he commenced the manufacture of electrical apparatus, being almost the first English electrical manufacturing engineer. He then began the development of the Chelmsford Works, which in a few years became one of the foremost electrical manufacturing establishments in the world. He acted as engineer for the Kensington central station, practically the first in England, and in this and subsequent undertakings did much toward the advancement of this branch of engineering. Col. Crompton has taken a leading part in the movement toward removing governmental restrictions which have been the cause of hampering electrical development in Great Britain. In 1895 he became president of the Institution of Electrical Engineers, and in 1898 he took an active part in organizing a corp of electrical engineers for national defence, of which body he became major upon the death of Dr. John Hopkinson. Shortly after the Boer war broke out Major Crompton took his command to South Africa, where it performed important service, and in recognition whereof its commander was created a C. B. Col. Crompton has carried out much experimental work in his laboratory, one of the commercial work. He had considerable part in starting the National Physical Laboratory of Kew and is one of its executive committee. Recently Col. Crompton has been much interested in the subject of the standardization of modern electrical machinery and in the standardization of small screws. He will present a paper before the Congress giving an account of the progress of electrical manufacturing standardization in Great Britain.

LIEUT.-COL. R. E. B. CROMPTON.

MR. W. DUDDELL.

Mr. W. Duddell, delegate from the Institution of Electrical Engineers, was born in London in 1872. After a primary education in private schools he took a course of a year at the College Stanislaus, Cannes, France. After serving during 1890-3 a three-year's apprenticeship with Messrs. Davey, Paxman & Co., the famous engineering company of Colchester, England, he attended a course in engineering and physics and carried out research work at the Central Technical College, London. He gained the Whitworth Exhibition in 1896 and the Whitworth Scholarship in 1897. Mr. Duddell is best known in connection with his work on the oscillograph and on the investigation of the electric arc. He obtained a premium for a paper read before the Institution of Electrical Engineers in 1898 and again in 1900, and in 1901 presented a paper on "The Resistance of e.m.f. of the Electric Arc." before the Royal Society of London. Mr. Duddell received a gold medal for his oscillograph at the Paris Exposition in 1900.

W. DUDDELL.

DR. R. T. GLAZEBROOK.

Dr. R. T. Glazebrook, F.R.S., delegate of the Institution of Electrical Engineers and Royal Society, was born at Liverpool on September 18, 1854. He was educated at London College and Trinity College, Cambridge, where in 1876 he was fifth wrangler and received the degree of B.A. Immediately after taking his degree he commenced the study of physics at the Cavendish Laboratory under Clerk Maxwell, and was demonstrator of the laboratory under Lord Rayleigh, which post he held for over ten years, until 1898. From 1881 to 1896 he was lecturer and assistant tutor at Trinity College in natural science, and from 1896 to 1898 was senior bursar of the college. He has served as secretary and as treasurer of the Cambridge Philosophical Society. In 1898 he became principal of the University College of Liverpool, which post he held until the following year, when he was appointed by the Royal Society first Director of the National Physical Laboratory, which position he now occupies. He was elected Fellow of the Royal Society in 1882, on the Council of which he has served; has been secretary of the Electrical Standards Committee of the British Association since 1883, and is a member of the Board of Trade Committee on electrical units. Dr. Glazebrook has experimented on the value of the ohm and the e.m.f. of the Clark cell, and took part in the definition of

DR. R. T. GLAZEBROOK.

electrical units adopted by the English Government, and later by the Chicago International Electrical Congress of 1893. He is the author of a textbook on "Practical Physics" and an elementary textbook on mechanics, light, heat and electricity. Dr. Glazebrook was president of the Physical Society of London, 1893-94. He was secretary of the B. A. for a number of years and acted in 1893 as president at the Nottingham meeting.

HUGH ERAT HARRISON.

Mr. Hugh Erat Harrison, delegate of the Institution of Electrical Engineers, was born April 23, 1859. His education was pursued at the University College School, London University and University College, at which latter he gained a prize in chemistry and physics in 1877. After studying a short time at Paris he took the degree of B.Sc., and obtained honors in experimental physics in 1880. In 1881 Mr. Harrison took up electrical engineering, and that same year became managing engineer at the Sheffield branch of the Hammond Company. In 1882 he organized and became principal of the Electrical Engineering College in Red Lion Square, London, a school conducted by the Hammond Company. In 1889 he organized the Electrical Standardizing, Testing and Training Institution at Faraday House, London, becoming principal when it was opened in 1890. Mr. Harrison has contributed largely to the technical press, and is the author of certain sections of Molesworth's well-known Pocket Book. He is an associate member of the Institute of Civil Engineers, a Fellow of the Physical Society, and lately a member of the Council of the Institution of Electrical Engineers. He has served under the Board of Trade as electrical inspector for Croydon, Godalming and Tunbridge Wells, and was assistant examiner in magnetism and electricity to the Board of Trade from 1887 to 1901. He has recently published a series of papers entitled "Notes on Electrostatics Treated Opsigraphically" in the London *Electrical Times*.

HUGH ERAT HARRISON.

PROF. JOHN PERRY.

Prof. John Perry, delegate of the Institution of Electrical Engineers and of the Royal Society, was born at Garvagh, Ulster, in 1850. His early education was received at the Model School, Belfast, where among other prizes he won a silver medal in natural science. After serving an apprenticeship in the Dock Foundries, Belfast, going through the drawing office and shops, he gained a mathematical scholarship and the Peel Prize on matriculating at Queens College, Belfast. After gaining many college prizes and exhibitions he graduated in 1870 as Bachelor of Engineering in the Queens University of Ireland with first honors, a gold medal and the Peel prize. He gained the Whitworth exhibition in 1868-69 and the Whitworth scholarship in 1870. Among other degrees he has received have been those of Master in Engineering, D.Sc. and LL.D. of Glasgow in 1901. After teaching physics in England for several years Prof. Perry went to Japan as joint Professor of Engineering in the Imperial College of Engineering, where he remained until 1879. Upon his return he organized the works of Messrs. Clark & Muirhead for the manufacture of insulated wire, with a department for the testing of dynamo machines, etc. In 1881 he was awarded the silver medal of the Society of Arts. In 1881 he became Professor of Mechanical Engineering and Applied Mathematics at the Finsbury Technical College. In 1885 he was elected to a Fellowship of the Royal Society, and in 1896 he became Professor of Mechanics and Mathematics in the Royal College of Science, London. In 1902 he was president of Section G of the B. A. and was president of the Institution of Electrical Engineers in 1900-01. Prof. Perry is the author of numerous papers giving the results of original research in various branches of pure and applied science, many of the earlier of these having been written in conjunction with Prof. Ayrton. He is also the author of a number of books, including "Elementary Treatise on Steam," "Practical Mechanics," "Calculus for Engineers," "Applied Mechanics," "Steam, Gas and Oil Engines" and "Practical Mathematics for Artisans."

PROF. JOHN PERRY.

ROBERT KAYE GRAY.

Robert Kaye Gray, delegate of the Institution of Electrical Engineers, has been closely identified with the submarine telegraph from the days when it passed from the stage of experiment to that of commercial and engineering development. His father, Mr. Matthew Gray, was for many years managing director of the great Silvertown cable works, and it was here that he received a thorough training in everything relating to submarine telegraphy. During this period he became identified with the engineering side of the art, and among his contributions to it was a double-lever signaling key and hand switch. He was a pupil of Sir Charles Bright and in 1870 went out with him to lay the first West India cables. Later he became engineer-in-chief of the Direct Spanish Telegraph Co. At present Mr. Gray is managing director of the India Rubber & Gutta Percha Telegraph Works, at Silvertown; chairman of the Spanish National Submarine Cable Co.; director of the Cuba Submarine Telegraph Company, the South American Cable Company, and the West African Telegraph Company. Mr. Gray succeeded Mr. James Swinburne as president of the Institution of Electrical Engineers on March 26, 1903, Mr. Swinburne having resigned in favor of Mr. Gray that the latter might organize the reception of the International Telegraph Congress, held in London that year. On April 23 of the same year he was elected president for the term of 1903-4 and on April 28 was re-elected president for the first half term of the year 1904-5.

ROBERT KAYE GRAY.

MARIUS LATOUR.

M. Marius Latour, delegate of the Société Internationale des Electriciens, was born in 1875 in the south of France. Until 1897 he applied himself to literary and philosophical study, but in that year took up scientific studies, which since then he has followed exclusively. At the Sorbonne he became the pupil of Lippmann, Pellat and Appel, and after gradution from the University of France, entered the Ecole Superieure d'Electricité, where he continued his studies until 1900. Since that time M. Latour has made a specialty of the study of dynamo-electric machinery, particularly in connection with commutator alternating-current generators and motors. M. Latour is a consulting electrical engineer for the General Electric Company. He will present a paper before the Congress dealing with the type of machine with which his name has been closely associated the past four years.

M. LATOUR.

PROF. GUIDO GRASSI.

Prof. Guido Grassi, delegate of the Associazione Elettrotecnica Italiana, was born at Milan, Italy, May 28, 1851. He obtained his primary education in the primary and high schools of Milan, and was graduated from the University of Pavia in the Department of Physics with the degree of Ph.D. Upon graduating he accepted the chair of Technical Physics in the Polytechnic Institute of Naples, then became Professor of Electricity and finally director of the Polytechnic. Upon the death of the lamented Prof. Ferraris, he was called to the Professorship of Electricity at the Museo Industriale of Turin, which chair he now occupies. Prof. Grassi's early work was largely in the theory and application of heat, and more recently he has

PROF. GUIDO GRASSI.

been chiefly occupied in researches in electricity and magnetism. There has just issued from the press from Prof. Grassi's pen the first volume of a comprehensive course in electricity, which will be completed in three volumes. Prof. Grassi is a member of the International Jury at the St. Louis Exposition, and is also a delegate of the Associazione Elettrotecnica Italiana to the Congress.

E. JONA.

Mr. E. Jona, delegate of the Associazione Elettrotecnica Italiana, was born in Biella, Italy, October 1, 1860. His early education was obtained in the primary and high schools of Turin, upon conclusion of which he entered the Electrotechnical Institute of Liege, Belgium, from which he was graduated with the degree of Electrical Engineer. Mr. Jona is the chief engineer of the well-known firm of Pirelli & Co., of Milan, Italy, makers of electric light, telephone, telegraph and submarine cables, and all kinds of material in which rubber enters. He has done important work in connection with the laying of submarine cables for the Italian Government in the Red Sea and to connect the Italian colony of Assab, as well as cables for other foreign governments and private companies. Among Mr. Jona's contributions to electrotechnical science may be mentioned a valuable paper entitled "The Determination of Sparking Distances in Oils and Other Liquid Insulators," read before the Associazione Elettrotecnica Italiana. He has also published a work on the design, construction and laying of submarine telegraph cables. Several articles from his pen have appeared in the electrical journals, among them being one entitled "A Graphical Method of Finding the Location of a Break in a Submarine Cable," and another on "The Determination of a Fault in a Submarine Cable While It is Being Picked up for Repairs." Mr. Jona will present a paper entitled "Insulation of High-Tension Cables."

E. JONA.

Among other delegates to the International Electrical Congress are the following:

State Councillor W. Litzrodt, official delegate of the German Telegraph Department; Mr. Joseph Vater, chief manager of the Royal Hungarian Technical Office of Telegraphs and Telephones, delegate from Hungary; Mr. Bela Gati, of the Technical Office of the Royal Hungarian Telegraph and Telephone Department, delegate from Hungary; Prof. Ferdinand Weber, delegate from Switzerland; Mr. J. C. Shields, delegate from India; Señor Guillermo A. Puente, delegate from the Institutions of Engineers of the River Platte; Dr. R. A. van Sandick, delegate from the Royal Institute of Netherlands Engineers; Lieut.-Commander Joseph L. Jayne, U.S.N., delegate from the U. S. Navy Department.

W. LITZRODT.

The co-operating American associations have each been requested to appoint delegates to represent them at the Congress. Among those who have been thus designated are the following:

JOSEPH VATER.

American Institute of Electrical Engineers—Prof. C. P. Steinmetz, who will present two papers before the Congress, one on the luminous electric arc, and another developing the theory of the single-phase motor; Prof. M. I. Pupin, who will present a paper on electrical impulses and multiple oscillators, and Mr. Ralph D. Mershon, who will present a paper discussing the maximum distance to which power can be electrically transmitted.

American Electrochemical Society—Prof. W. D. Bancroft, who will present a paper on the chemistry of electroplating; Prof. H. S. Carhart, who will present two papers as noted above, and Dr. Louis Kahlenberg, who will read a paper on the electrochemical series of the metals.

National Electric Light Association—There will be three representatives of the association—Mr. George Eastman, Prof. F. A. C. Perrine and G. Ross Green. The first-mentioned will present a paper on alternating-current distributing systems, and Dr. Perrine will discuss in a paper the subject of American practice in high-tension line construction and operation.

BELA GATI.

Association of Edison Illuminating Companies—The three delegates of the association will be Messrs. W. C. L. Eglin, L. A. Ferguson and Gerhard Goettling, who will each present papers, Mr. Eglin treating of rotary converter and motor-generator city distribution; Mr. Ferguson of underground electrical construction, and Mr. Goettling of the storage battery in central station work.

International Association of Municipal Electricians—The representatives will be Messrs. W. H. Bradt, F. C. Mason and Walter N. Petty.

The American Electrotherapeutic Association will be represented by Drs. Herbert Boggs, Charles R. Dickson and Dr. James Herdman, each of whom will present a paper.

Wireless Telegraph Fact and Fiction.

Mr. John D. Oppe, vice-president and general manager of the Marconi Wireless Telegraph Company of America, writes us as follows: "My attention has just been called to a paragraph in your issue of July 30 in which it is stated that the Marconi Wireless Telegraph Station at Siasconset, Mass., has been discontinued, the United States Government having refused to permit the continuance of the station on the South Shoals Lightship. Will you allow me to point out that our station at Siasconset has not been discontinued, but that on the contrary it is in active commercial operation.

"Several of our steamers are equipped with apparatus capable of communicating direct with the Siasconset station and we are equipping the balance with special apparatus, so that in future all vessels equipped with Marconi apparatus will communicate direct with Siasconset instead of via the lightship, as formerly. This service will be a partial remedy for the loss of facilities for communicating via the lightship and will enable communication to be made with vessels considerably earlier than is at present generally the case, although not so early as previously, before communication with the lightship was cut off."

Mr. G. W. Colles, of Milwaukee, Wis., writes us as follows in regard to such reports as are noted above:

"The writer, doubtless equally with a large number of other misguided persons, has been led by articles appearing in your columns and those of the newspapers generally to the settled conviction that the De Forest wireless telegraph system had been adopted by the United States Government, and thereby made a practically clean sweep of the American field. Now comes a rival company with the statement substantially that this is all a pack of lies. The De Forest Company had also previously made like allegations with respect to the Marconi Company.

"It is plain that there has been falsehood and misrepresentations on a large scale somewhere, and the only doubt is as to where to fix the responsibility. It seems very regrettable that this should form part of the stock in trade of the disputing competitors in this field, and that public sentiment on the subject should not be sufficiently strong to make it a boomerang to the concern that uses it to promote business. But even though it is true that the public loves to be humbugged, it does not follow that scientific men do, and it seems to me that the function of technical journals is to find out and supply their readers with the facts in the matter and not merely with the partisan statements of rival companies."

We can only say that the technical journals appear to be doing their "level best" to ascertain and publish the facts.

A Physical Conception of Some Alternating-Current Phenomena.—III. (*Concluded.*)

BY LAMAR LYNDON.

COMBINED INDUCTANCE AND CONDENSANCE.

FROM the previous considerations it is plain that inductance and capacity in the same circuit tend to neutralize each other, and in certain instances may completely do so.

If the resistance, r, = 10 ohms, L of the inductance = 0.5 henry, Jm of the capacity = 50 microfarads, f = 100 cycles per second, and impressed E = 100 volts, their relationships are shown by the diagrams, Fig. 8.

Inductance reactance = $2\pi f L = 18.84$,

Capacity reactance $= \dfrac{1{,}000{,}000}{2\pi f Jm} = 31.84$.

The reactance e.m.f. in the circuit then is 31.84 — 18.84 = 13 volts, while the resistance e.m.f. is 10 volts for each ampere flowing. The impedance, then, of the circuit = $\sqrt{10^2 + 13^2} = 16.4$. $I = \dfrac{100}{16.4} = 6.1$ amp.

The tangent of the angle—which is the angle of lead in this case, as the capacity reactance is the greater—is $\dfrac{13}{10} = 1.3$, corresponding to 48° 30″. Cosine 48° 30″ = .6626. The resultant voltage, therefore, is .6626 × 100 = 66.26 volts. Watts put into circuit = 66.26 × 6.1 = 404 watts. Apparent watts = 610 watts.

The formula, then, for current flow in a circuit containing resistance, inductance and condensance is

$$I = \frac{E}{\sqrt{R^2 + \left(2\pi f L - \dfrac{1{,}000{,}000}{2\pi f Jm}\right)^2}} \qquad (14)$$

Also formula for tangent of angle lag or lead is

$$\frac{2\pi f L - \dfrac{1{,}000{,}000}{2\pi f Jm}}{R} \qquad (15)$$

the greater of the two quantities in the numerator showing whether the current "leads" or "lags behind" the impressed e.m.f.

Equation (14) shows that when the condenser and inductance reactances are equal, the formula reduces to $I = \dfrac{E}{R}$, showing that the summation of the three e.m.f's acting is equal to the impressed e.m.f., and the resistance alone opposes the flow of current, the two reactances neutralizing each other. This is also shown in Fig. 9, where it will be seen that the ordinates of L, L, L, L are at every instant exactly equal and opposite to those of c, c, c, c, L, L, L, L being plotted 90° or one-fourth cycle behind the current, and c, c, c, c being plotted one-fourth cycle ahead of the current curve, i, i, i, i.

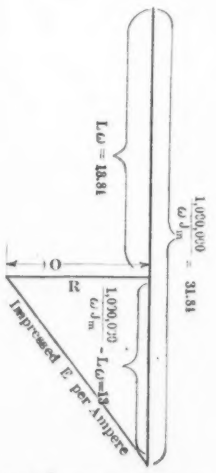


FIG. 8.—RELATION OF INDUCTANCE AND CONDENSANCE.

The resultant e.m.f. is, of course, equal to the impressed e.m.f. = $R I$.

With a given inductance and capacity, there is only one frequency at which they will neutralize, since their reactance voltages must be equal, and any increase in frequency will reduce the voltage of the condenser reactance, while it will increase the voltage of the inductance, and the reverse is true for a decrease in frequency, as is obvious from equations (2) and (12). This neutralization is, however, independent of resistance, current flow, or impressed e.m.f.

Complete neutralization of reactance is called *resonance*.

Since for resonance, $2\pi f L = \dfrac{1{,}000{,}000}{2\pi f Jm}$, the frequency at which resonance will occur is:

$$f = \frac{1}{2\pi}\sqrt{\frac{1{,}000{,}000}{L\,Jm}} \qquad (17)$$

As an example assume a circuit in which L = 0.44 henry and Jm = 16 microfarads:

$$f = \frac{1}{6.28}\sqrt{\frac{1{,}000{,}000}{0.44 \times 16}} = 60 \text{ cycles per second.}$$

When inductance and capacity are both present in series relationship, voltages much greater than the impressed may manifest themselves locally at the terminals of the two reactances. For instance, in the previous example with conditions as shown in Fig. 8, the impressed e.m.f. = 100 volts.

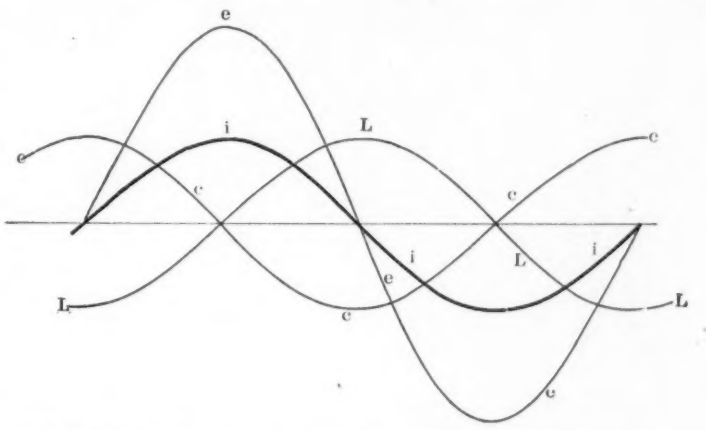


FIG. 9.—RELATION OF INDUCTION AND CONDENSANCE IN CIRCUIT.

I = 6.1 amp.

f = 100.

e.m.f. at inductance terminals = 6.28 × 100 × 0.5 × 6.1 = 1,915.4 volts.

e.m.f. at condenser terminals $= \dfrac{1{,}000{,}000 \times 6.1}{6.28 \times 100 \times 50} = 1{,}930$ volts.

The voltage at the terminals of the two reactances is always equal, if the local resistances in them be neglected.

The discrepancy which occurs in calculations as above is due to the failure to carry 2π out to its full value, i. e., 6.28318.

In the case of resonance, the local voltages rise much higher than where partial neutralization only takes place, because the current flow is greatest when resonance occurs, and I is one of the factors that cause the voltage rise. In the case of the circuit in which L = 0.44 henrys, Jm = 16 microfarads, R = 5 ohms, and f = 60; if the impressed e.m.f. be taken at 250 volts, $I = \dfrac{E}{R} = 50$ amp. Voltage at terminals of inductance = 6.28 × f × L × I = 8,290 volts. This is equal to the potential set up at the condenser terminals =

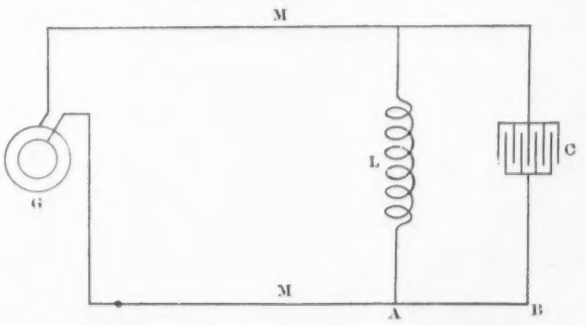


FIG. 10.—DIAGRAM OF CIRCUIT WITH INDUCTANCE AND CONDENSANCE.

$$\frac{I \times 1{,}000{,}000}{6.28 \times f \times Jm} = \frac{50 \times 1{,}000{,}000}{6.28 \times 60 \times 16} = 8{,}290 \text{ volts.}$$

Currents which are not in phase with each other may be combined just as are e.m.f's. In the case of two parallel branches of a circuit, as shown in Fig. 10, the current in branch A will lag behind the impressed e.m.f., and that in branch B will be in advance of the impressed e.m.f., it being understood that the terms "lag" and "lead" are used in the sense before explained.

The current through the mains $M\,M$ is the algebraic sum of the currents in A and B, if the *instantaneous* values be taken.

Fig. 11 shows the curves of impressed e.m.f. (e, e, e, e), current

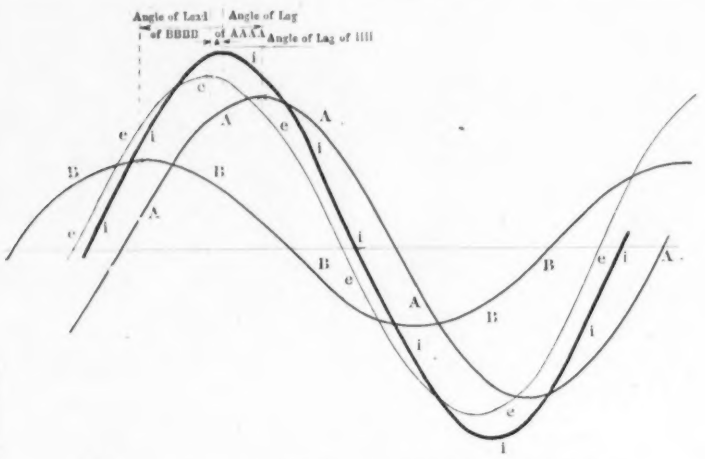


FIG. 11.—E.M.F., CURRENT AND RESULTANT CURVES.

in A (A, A, A, A), current in B (B, B, B, B) and the algebraic sum (i, i, i, i), which is the resultant current through $M\,M$.

It is inconvenient to plot these curves accurately to scale and the

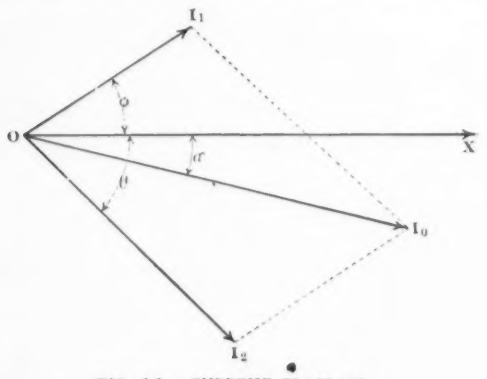


FIG. 12.—CURRENT DIAGRAM.

method of combining forces graphically is best suited to the investigation of such circuits.

If in Fig. 12 the horizontal line, $O\,X$, represents the impressed e.m.f., the current through A is equal to I_1.

$$I_1 = \frac{E}{\sqrt{R^2 + (\omega L)^2}}$$

in which $\omega = 2\pi f$.

The tangent of the angle of lag $= \dfrac{L\omega}{R}$.

Lay off $O\,I_1$ equal to I_1, and at an angle ϕ the tangent of which is $\dfrac{L\omega}{R}$ behind the e.m.f.

Also the current through "B" is $I_2 =$

$$\frac{E}{\sqrt{R^2 + \left(\dfrac{1{,}000{,}000}{\omega Jm}\right)^2}}$$

and its tangent is $\dfrac{\dfrac{1{,}000{,}000}{\omega Jm}}{R}$. Lay off $O\,I_2$ equal to I_2, and at the angle θ, ahead of the e.m.f. The resultant current is the diagonal of the parallelogram made on $O\,I_1$ and $O\,I_2$. As may be seen, it is in this case slightly ahead of the impressed e.m.f. by an angle $= \alpha$.

As an example take a circuit in which branch A has a resistance of 5 ohms and an inductance of .02 henry.

Branch B has a capacity of 50 microfarads and 8 ohms.

Assume an impressed e.m.f. of 100 volts and a frequency $= f$ of 100 cycles per second, $2\pi f L = 6.28 \times 100 \times .02 = 12.56$ volts.

Impedance of branch 'A" $= \sqrt{(5)^2 + (12.56)^2} = 13.5$. Current through branch "A" $= \dfrac{100}{13.5} = 7.42$ amp. The resultant e.m.f. and the current lag behind the impressed e.m.f. by an angle, the tangent of which is $\dfrac{L\omega}{R} = \dfrac{12.56}{5} = 2.513$, which angle is 68° — 18″.

The impedance of the condenser circuit $=$

$$\sqrt{R^2 + \left(\frac{1{,}000{,}000}{\omega Jm}\right)^2} = \sqrt{(8)^2 + \left(\frac{1{,}000{,}000}{50 \times 628}\right)^2}$$

$= 32.82$. Current $= \dfrac{100}{32.82} = 3.05$ amp.

$$\text{Tangent angle of lead} = \frac{\dfrac{1{,}000{,}000}{\omega Jm}}{R} = \frac{31.83}{8} = 3.98,$$

corresponding to an angle of 75° — 54″. Combining these two currents in their proper phase relation, the sum is the current through the main circuit. This addition is done as shown in Fig. 13, in which $O\,E$ is the reference line representing the impressed e.m.f. From O at an angle of 68° — 18″ *upward* lay off to any convenient scale 7.42 amp. At an angle of 75° — 54″ *downward* lay off to the same scale 3.05 amp. Complete the parallelogram as indicated by the dotted lines. The diagonal from O gives the value of the resultant current through the main circuit at 5.24 amp., and shows that this current is 48° — 36″ behind the impressed e.m.f. Thus it will be seen that in this particular case the combined currents of the two branches is less than that in the single branch, A, and the addition of branch B, which affords a second path for current flow to the circuit in which the single path, A, exists, actually reduces the current flow through the circuit.

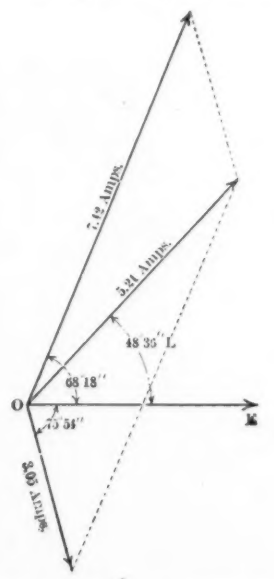


FIG. 13.—CURRENT DIAGRAM.

If the two branches, A and B, had no resistance in them, the current through the main circuit would be zero. The currents being equal and opposite would neutralize. The physical conception of this condition is that of current flowing into the condenser, charging it while the energy previously stored in the inductance discharges. This discharge sets up an e.m.f. opposing the impressed e.m.f. and also furnishes the current to supply the charge in the condenser. On reversal of the impressed e.m.f. the condenser discharges into the inductance, at the same time opposing the impressed e.m.f. Thus current will flow in the local circuit between A and B, but none will flow into the main circuit, as the impressed e.m.f. is always opposed by an equal and opposite e.m.f. The current which surges back and forth between A and B is a so-called "wattless current," because its net effect in doing work is zero. During the transfer of energy from the inductance to the condenser, or vice versa, an amount of energy is transferred proportional to the current flow, but is restored when discharge takes place, sending the current in the opposite direction and back into the reactance from which it was first taken.

The German Electrical Exhibits at the World's Fair.—II.

By Franz Welz.

IN the group of "Electric Lighting" in the German space, the one new feature of special interest is the new type of Bremer lamp (see Fig. 6). The essential point of this lamp is that instead of the ordinary carbon, it uses a special kind, impregnated with certain chemicals containing principally fluorspar and compounds of calcium and strontium. According to tests made by Prof. Dr. Wedding, of Germany, this lamp consumes 0.4 to 0.6 watt per cp, which means that it is about three times more economical than the ordinary arc lamp. The color which is given to the light of this lamp by the admixture makes it softer and more agreeable to the eyes, and it is especially very effective for decorative lighting. When this lamp was first placed on the market the frequent and intense fluctuations in the light when the carbons were regulating gave much trouble. The chemicals in the carbons formed slags when burning and a little brass hammer, operated by two strong magnets, was needed to shake up the carbons at intervals in order to keep them from sticking. This disadvantage is avoided altogether in the new type of lamp. The carbons are now prepared so that they form almost no slag, and the regulation of the lamp is, therefore, much improved. In construction the Bremer lamp differs materially from the ordinary type. The carbons are brought together under an angle of about twenty degrees. On the inner side of this angle is a blowing magnet which serves to blow the arc downward in order to make it long and efficient. This arrangement has the advantage that the whole intensity of the arc can be utilized, as there is in the path of the light no body to produce a shadow, and the light is thrown straight down. The negative carbon passes through an oval opening in the holder, and when the carbons are consumed, thus increasing the distance between them, and therewith augmenting the voltage of the arc, this holder is operated by a magnet bringing the carbons closer together. The lamp can be successfully made for both direct and alternating current, two lamps being used in series on a 110-volt circuit.

This lamp has come into extensive use in Europe, especially for exterior decorative lighting of big department stores, etc., but its application for the interior of buildings has been very limited on account of the injurious vapors which are produced when the carbons

FIG. 6.—BREMER LAMP.

are burning. In order to remedy this difficulty a German carbon factory has recently taken out a patent for using in this lamp beneath the carbon holder a few drops of ammonium carbonate, thus neutralizing the poisonous vapors by forming ammonium nitrate with them.

As far as the group of "Telephony and Telegraphy" is concerned, Germany shows in its section quite a number of instruments of interest and novelty. One of the latest improvements applied to telephone lines is the Pupin self-induction coil as employed for overhead and underground telephone lines. The practical application of both kinds of these coils is shown in Fig. 7. These coils are inserted at intervals in the cable or interurban overhead lines, and serve to diminish the damping effects of the cable line upon the talking current. The application of Prof. Pupin's theory allows the arrangement and the dimensions of the coils to be so chosen that a certain decrease of the damping effect and a considerable improvement in the clearness and strength of the sound take place. For cable lines the self-induction coils are wound on one round iron core for both wires of the circuit, and the cores with the coils are mounted in a water-tight, cast-iron box, as shown in the figure. The beginning and the end of the coils are brought out separately to a joint, so that the whole apparatus can be directly inserted in the cable line. The apparatus exhibited is built for a cable of fourteen double lines. For overhead lines the coils for the two wires of the circuit are con-

FIG. 7.—PUPIN INDUCTION COILS.

structed separately and each is mounted on top of an insulator. The insulator bearing the Pupin coil, together with a lightning arrester, are fastened to an iron bracket, which rests on an iron cross arm, as clearly shown in Fig. 7.

Besides the Pupin coil the firm of Siemens & Halske also exhibits a universal measuring instrument for telegraph and telephone lines. This instrument consists of a galvanometer of the movable-coil type, together with a Wheatstone bridge, and can be used for the following measurements: The determination of the resistance of single and double lines; the insulating test of a single line and earth and of double lines between each other; the measurements of exterior current in the case of single lines; the measurements of current and voltage.

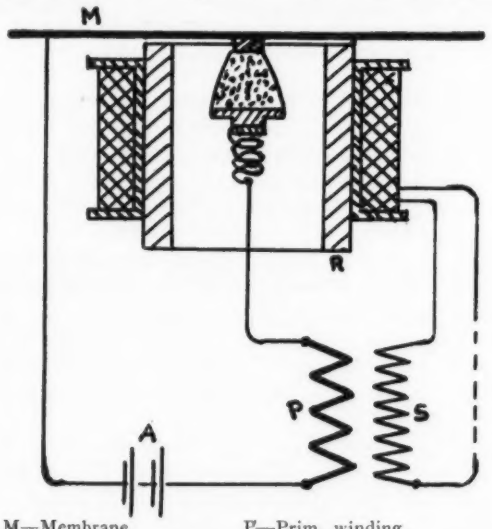
In the exhibit of the "Land und Seekabelwerken" (Fig. 1) we find, in addition to several samples, a ring of telephone cables for 1,000 double lines; the insulation of the wires consists of paper of different colors. An exhibit embodying some new and very interesting features is that of Prof. Dr. Cerebotani, of Munich. This famous inventor is showing his new telegraph apparatus for the transmission of pictures, a similar apparatus for setting type by telegraph and a meteorological telephone. The mechanical execution of the invention has been entrusted to the metal works of A. Silberman, of Berlin.

In the last group of the official classification, the group of "Various Applications of Electricity," Germany certainly gives in the most extensive manner a splendid testimony of the considerable advance which that country has made in very recent years in the construction of electrical measuring instruments for practical use and of electrical scientific instruments and apparatus for laboratory and educational purposes. A mere glance upon this section convinces the visiting engineers that the German electrical manufacturers combine with profound scientific knowledge, ingenuity and practical skill in the construction of apparatus of perfect accuracy and reliability.

The largest contribution to this section is furnished by the firm of Siemens & Halske, of Berlin. The exhibits of this firm are arranged in the following four groups: First, complete measuring equipments for scientific and technical purposes; second, typical measuring instruments for scientific and technical purposes; third, switchboard instruments for the different kinds of current, and fourth, apparatus for transmission of the movement of the compass needle.

Following this classification, we find as one of the most interesting pieces of apparatus a compensation device for very exact measuring of current and voltage according to the compensation method of Poggendorf and Dubois-Reymond. The readings are obtained by comparison with the e.m.f. of a standard cadmium cell, with negligible temperature coefficient. The arrangement of the apparatus has the great advantage that the contact resistances have only one-

tenth the effect of the connections used heretofore. Besides this all sliding contacts are of the brush type, thus reducing to a minimum the contact resistance. The precision crank rheostat belonging to this outfit has a range of 0.0001 to 1,600 ohms, and it is noticeable that the contact resistance at the turning point of the cranks is of a constant value. The measuring of current with this compensation apparatus is made by noting the difference of potential at the terminals of a standard resistance. In connection with the above apparatus are shown a number of these standard resistances for 200 and 3,000 amp., with different connection devices. Then follows a number of measuring arrangements for the determination of resistances, under which we find most interesting the instruments named below: A double-crank measuring bridge for determining resistances from 1 to 0.000001 ohm, according to the connection of Thomson. The bridge contains two sets of cranks of 9 x 0.1, 9 x 1, 9 x 10, 9 x 100 ohms each, and two additional resistances of 10, 50 and 100 ohms each. By using a special junction piece, this bridge can also be employed for the measuring of resistances from 0.1 to 10,000 ohms in the Wheatstone connection. A measuring bridge according to Thomson serves specially for quick factory tests, and on account of its size it can be easily carried from one place to another. For measuring resistances of more than 0.1 ohm the Siemens & Halske Company is building a number of different bridges similar in construction to the ones described above, and among the various exhibits we find samples of all the types as used in the laboratories or in actual installation work. They also exhibit a handy telephone bridge



M—Membrane. P—Prim. winding.
R—Steel tube. A—Storage battery.
S—Sec. winding.

FIG. 8.—SIEMENS & HALSKE VIBRATOR.

especially made for testing the installation for protection against lightning. In the next group are given some methods with the necessary apparatus for the determination of induction factors and the loss of energy in alternating-current apparatus. The method employed is the following: An alternating current is first sent through the apparatus to be tested and a telephone connected with the bridge will cease to sound if a certain resistance is inserted. The other branch of the bridge contains a resistance of a known value and a standard inductance without iron core. If now, under the same conditions in the bridge, a direct current is sent through the apparatus, a galvanometer will show a current, and in order to make the needle go back to zero it is necessary to add resistance in the bridge. This added resistance gives the alternating-current loss in the apparatus. The devices for the carrying out of these tests are of special interest and a more detail description of same will, therefore, be desirable. On account of the fact that the inductance as well as the resistance of apparatus, in involving considerable losses, depend very largely on the frequency, good results are obtained only when the bridge is fed with alternating current having a nearly perfect sine wave. All apparatus built on the principle of the interruption of the current naturally gives a very much distorted wave form. If a pure sine wave shall be produced with an induction coil it is necessary to replace the break of the current in the primary circuit by changes of resistance. For this purpose the vibrator of Siemens & Halske can be used with great success. Fig. 8 shows clearly the construction of the apparatus exhibited by the above firm. Its principle of construction is that of a common microphone transmitter, with some little changes for the above special purpose. The vibrations of the membrane, producing variations of resistance in the primary circuit, induce in the secondary circuit an alternating current with a nearly perfect sine wave, which suits very well for the above measurements as long as the frequency does not exceed 1,000 cycles per second. In using membranes of different thicknesses alternating currents of 300 to 1,000 cycles per second and

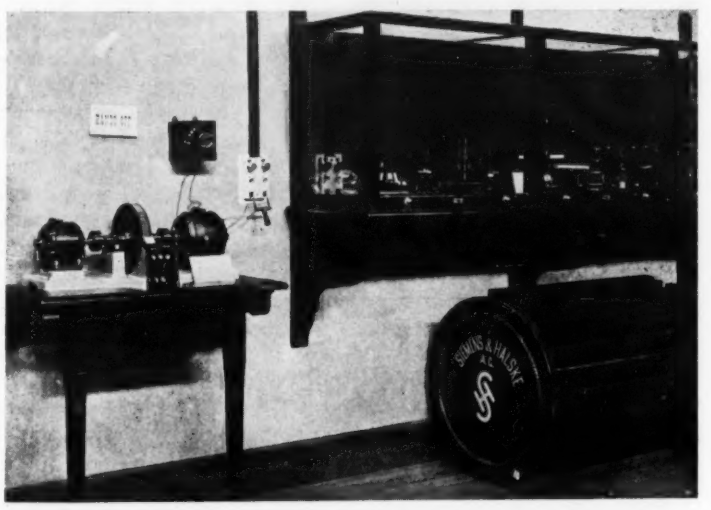


FIG. 9.—SIEMENS & HALSKE HIGH-FREQUENCY MACHINE AND IRON-TESTING APPARATUS.

of sufficient strength for this purpose can be produced. For higher frequencies it is necessary to use specially built machines, of which we find on exhibit one, as illustrated by Fig. 9. The essential part of this machine is a small toothed iron disc of about 20 cm. diameter and 2 cm. thickness, composed of several hundred very thin sheets of iron. These sheets are isolated from each other by a thin layer of varnish and are fastened by a rim of hard rubber. Opposite the teeth of the disc are placed at a short distance from them the poles of a horseshoe magnet, which is also composed of the thinnest sheet iron. The ends of the poles are pointed, so that the magnetic circuit is closed when the teeth of the disc are opposite the poles. The electromagnet is excited by direct current and if the iron disc is rotated by a shunt motor, alternating currents are induced in the coils surrounding the poles by the fluctuations of magnetism, resulting from the approaching and receding of the teeth before the magnetic poles. As the disc has 100 teeth, 100 full cycles are produced at each revolution. The number of revolutions of the shunt motor can be raised

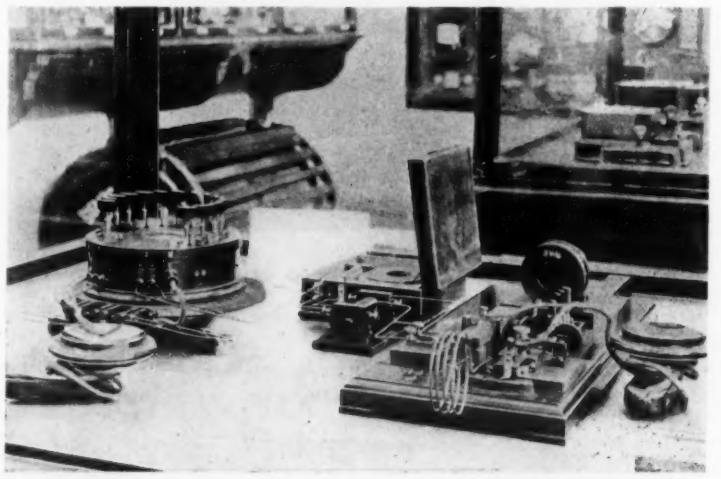


FIG. 10.—APPARATUS FOR THE DETERMINATION OF INDUCTION FACTORS.

to 4,000 per minute, giving a maximum of 6,600 cycles per second. A small dynamo, short-circuited on a resistance, is connected to the motor and the disc. The little motor runs, therefore, under constant load and small changes in the friction of the bearings do not vary the number of revolutions of the motor. The bridge used for these measurements, shown at the left in Fig. 10, rests on a ground plate of serpentine, on the periphery of which lies in a groove the potentiometer wire. The contact lever slides on this

wire by means of a small platinum wheel. In order to save the time for figuring out the results, a scale placed along the test wire gives at the right and at the left of the contact the ratio of the length of the wire. The case with the resistances is in the form of a hollow cylinder and encloses the galvanometer, which is placed in the middle. The marks on the binding posts indicate the proper way of connection. The next apparatus belonging to this arrangement is a precision standard of inductance as built by Siemens & Halske, according to the theory of M. Wien. In these standards the variation of the values of resistance and inductance due to changes in the frequency of the alternating current is entirely avoided. Differing from other constructions, very small binding screws are used in this apparatus, placed sufficiently outside of the magnetic field of the coil, and, instead of a solid conductor, a copper strand composed of a great number of very small insulated wires is used. This method of construction avoids all errors from eddy currents. The apparatus described above allows the determination of inductances down to 0.001 henry. For the determination of inductances below this value the Siemens & Halske Company exhibits a bridge, as seen at the right in Fig. 10, with which the smallest inductances down to 10^{-7} henries can be measured with an accuracy of 1 to 2 per cent. In order to avoid the errors from mutual induction, the bridge wire is arranged in a straight line and is reduced to 1 cm. The resistance box is replaced by a manganin wire 2 cm. in length, on which a sliding contact can be set with any degree of accuracy. In order to avoid the loss of time in finding the minimum, a variable inductance standard is used instead of the constant one. The variation of the inductance is produced by pushing an iron core, free from eddy-current losses, into the core of the standard inductance. The respective positions of the core can be read off from a scale. This bridge allows the determination of the inductance of a few turns of heavy copper wire with great accuracy and gives, therefore, a very convenient means for researches as to rapid electric oscillations. Finally, it may be mentioned that, according to the methods of M. Wien, the coefficients of mutual induction and the absolute values of inductance can also be determined with all these pieces of apparatus.

The Status of the Electric Contractor.

By A. H. SCOTT.

WHEN the International Electrical Congress opens in St. Louis on September 12 next, the attendance will be considerably augmented by the members of the National Electrical Contractors' Association of the United States, an organization that has specially arranged its fourth annual convention so that its members may attend the opening sessions of the congress. It seems fitting at such a time, therefore, to make brief note of this national organization of electrical contractors and the work it has accomplished, as well as that in which it is engaged, and the general effect of its work on electrical industries.

Prior to 1885 nearly all electrical apparatus was installed by the manufacturers or "parent companies," who also shared with the local lighting companies the work of installing interior wiring and appliances. But during the next five years the use of electricity as an illuminating agent became so general that a new field of industry was opened, a distinctly new line of business was created. Manufacturers and station managers realized that they were overburdened with a line of work that had grown to such proportions as to crowd the fields of production and operation, and in most cases they were glad to shift the overload on to the shoulders of the electrical contractors. Such a condition might indicate that from the starting point the pathway of the contractor was thickly strewn with roses; but, if the leaves had beauty of color and fragrance of odor, the thorns were long and none the less sharp, so that they who undertook the journey unprotected by footwear of high grade invariably fell by the wayside and were in most cases, lost in the jungle.

Although the business of interior electric wiring became from the very beginning one of importance among the building trades, the pioneers in the new industry failed to receive the recognition to which they were entitled. Architects made no provision for their work; carpenters, plasterers and other contractors made not the slightest effort to protect from injury the conductors and appliances already installed; and even the wiremen felt themselves treated as outcasts by the artisans of other trades, who, taking the cue from their employers, made no attempt to conceal that feeling of superiority which, more effectually than any other class distinction, places a dividing line between skilled and unskilled labor.

The advent of the consulting engineers might have tended to ameliorate to some extent a condition that was becoming more undesirable from day to day, and possibly, in some cases, the man of figures may have reached out a helping hand to his more practical brother, but such occasions were rare. It is a fact that no general improvement was noticeable until after 1891, in which year two of New York's ablest contractors made a compact between themselves to support each other on such occasions as might seem to require joint action. The labor situation in New York was far from satisfactory during the few years prior to 1892. The men had affiliated with a labor union and seemed to be imbued with a spirit of unrest. They imagined their organized strength was much in excess of that developed later by actual test. Hence every possible interpretation of the first law of nature demanded organization by the contractors, twelve of whom formed in August, 1892, the Electrical Contractors' Association. In electrical contracting circles—which, by the way, are constantly expanding—the survivors of the original twelve are nowadays referred to as "The Old Guard," and to them belong the credit as well as the responsibility of having formed the nucleus of the powerful national organization of to-day.

For nearly a decade this little handful of men held firmly together, and even their enemies must admire their grim determination to obtain unaided the recognition to which they were entitled in the building trades. Their methods were marked by a conservatism that is rarely found in young organizations. There was no mad rush for increase of membership. The business methods and reputation of each applicant were submitted to rigid examination, with the result that at the end of ten years their membership amounted to a scant two dozen, but it included men who had made enviable records for integrity and honor and whose signatures at the end of a contract were recognized as an ample guarantee for its fulfillment.

Other electrical contractors' organizations were forming, and meanwhile members of "the old guard" were extending their efforts which bore fruit in August, 1899, in the form of the Electrical Contractors' Association of New York State. This association has done much for its membership and for the general public. Honest competition in business is encouraged, sharp or questionable practice is decried and punished, and a spirit of friendship and good will extends from each member to the other, in sharp contrast with the old animosity that amounted often to personal hatred between excellent men whom circumstances had made competitors in business.

The wiremen soon felt the influence of the changed order of things and profited by it. They were now required to pass examination by competent experts as to their fitness for the work they were engaged to perform. The property owner or householder, knowing he would never see him again, had bidden affectionate adieu to the butcher or coal heaver who, in the guise of an electric wireman, had cheerfully attacked his buildings and decorations with axe, screwdriver and pliers and welcomed in his stead a competent mechanic who appeared on the scene equipped with a full kit of tools necessary to perform with neatness and dispatch whatever work might be desired.

Each association now directed its principal efforts toward the improvement of local conditions. The interests of their own members and those of their clients had been the principal consideration for all, and the members of each organization were well trained for the work in hand, but the new work was of greater magnitude than any yet attempted. The general public and contractors not affiliated with any of the existing organizations needed attention, the new conditions demanded greater power than was represented by any one organization and such power could be obtained only by a federation of all existing units. The task of formation was not a light one. Each association had claims of which it demanded recognition, varied interests had to be considered, and broad-minded but conservative leaders were needed to effect conciliation. It seems needless to say that men were found who were equal to the occasion and on the fifteenth day of July, 1901, in the city of Buffalo, one of the two founders was unanimously chosen to be the first president of the National Electrical Contractors' Association of the United States. During the

short life of the National Association it has made a record that may well be envied by the older organizations in the building trades.

That first year of life was a busy one. Plans were considered and formed. Men gave their energy and time to the organization with a whole-heartedness that made them forget or subjugate their own affairs and, thanks to the care exercised in the selection of members, almost every one of them was exerting his best efforts in behalf of the new movement. Committees were organized and the men selected for such special service were chosen because of particular qualifications that especially fitted them for the work to be done.

The "Committee on Standards" secured valuable results in the manufacture of fittings and specialties that were previously of such size and form as might be convenient to individual makers, but that can now be obtained, from any of the leading manufacturers, of uniform dimension and design, both of which conform to the requirement of practical conditions. Manufacturers have been quick to see the advantages of such uniformity of production. Whereas in former years the various requirements of several markets compelled a multiplicity of detail for the production of one line of goods, the present conditions permit the production of a single design, based on practical observation, that is acceptable in most cases throughout the country.

At the close of the first year, when the fall of the president's gavel opened the second annual convention in Atlantic City, on July 14, 1902, he and his officers realized that although much had been done, there was still much to be accomplished, and notwithstanding all the sacrifices and all the labor, little more than a beginning had been made with the real work of the association. Toward the close of the convention the association celebrated its first birthday by again electing to the office of chief executive the man who had led it from the first short steps of infancy to the long, manly strides that had out-distanced many older bodies and that had won for it recognition from all the building trades. Since the beginning of the second year, the "Committee on Code" has accomplished excellent results from its co-operation with the Electrical Committee of the Underwriters' National Electric Association, which speedily recognized the power of the National Electrical Contractors' Association to aid it in its work of uplifting the standard of electrical construction, of strengthening the old, and building up new safeguards around that large portion of the public affected by the rapidly increasing use of electric current.

For a number of years the impression had prevailed in certain circles that the interests of the underwriters were at variance with those of the electrical contractor. Perhaps there was reason, in some cases for the idea on one side, that the "contractor" had tried to squeeze past the rules and needed watching, and, from the other point of view, that the "inspector" had made too literal interpretation of one or more rules that "had never been intended to apply to a case such as that under discussion," possibly an idea that the "contractor" would make his work conform to the requirements of the rules only under compulsion, or that the "inspector" by his interpretation of the rules, had created unnecessary difficulties or had overburdened the work with needless technicalities; but, if such ideas prevailed, they are rapidly losing ground.

The following year was a notable one in the history of the building trades. Capitalists were prepared to release their holdings with unprecedented liberality. Extensive building operations were contemplated and in many cases actually begun, prospects were exceptionally bright for operators and workmen and the "Full Dinner Pail," with all that it implies, seemed assured for the next five years or longer, when suddenly the aspect of things changed, great black clouds appeared on the horizon and spread with amazing rapidity across the sky. Capital quickly took alarm and withdrew to await a clearing of the atmosphere. Building projects of great magnitude were suspended or entirely recalled, and the building contractors of New York found themselves exposed to the full fury of a storm, caused by the action of organized labor, that threatened to overthrow the work of years.

Each trade had an employers' organization that attempted to adjust the difficulties of its own members, and by reason of such division of power, with no central body, they were not in position to cope with the powerful federation of labor unions. Clearly there was but one course to pursue: unity of mind and action was the one thing needed, a federation of employers must be formed and a leader must be chosen. The promoters of the contemplated movement realized that failure would be disastrous. It might mean financial ruin to business enterprises that had absorbed the best energies of more than one generation. They knew that the leader of their choice must be a man of superior moral, physical and mental attainments; he must have even a superabundance of courage, dogged determination and physical endurance. He must hold the weaklings in line and must spur to greater effort the very men who would make him leader.

It would appear that there must have been plenty of such men among the older building trades, those trades whose members had even referred to the newcomer as an 'inconsiderable quantity," but if those older trades held the man, he was not discovered. When the crisis came it gave full recognition to the National Electrical Contractors' Association of the United States, for its president was unanimously elected to the presidency of the Building Trades Employers' Association of New York, to which office he has been recently elected for a second term.

Since July, 1903, the National Electrical Contractors' Association has progressed beyond expectation, the membership has increased in extraordinary degree and the growth would have been much greater but for that conservatism that insists on a membership comprising only those contractors who are in good standing in their respective communities. Under the direction of a Western president much valuable work has been accomplished in the past fourteen months. The old work of the association has been prosecuted vigorously and trade arrangements have been consummated that are beneficial alike to manufacturers, dealers and contractors. The prospects of the association have never been so bright as now. Its growth of membership and its power among the building trades are assured facts, because its affairs are directed by men of integrity and honor who have high places in the business communities of this country.

The Growing Duties and Responsibilities of the Municipal Electrician.

BY CAPT. WM. BROPHY.

AT the time of the introduction of the electric light in this country the only field for the electrician or electrical engineer was that of the electric telegraph, and the knowledge possessed of high tension currents or the energy required for the production of this new form of artificial lighting by them was very limited indeed. But they were the only ones to look to to provide for the transmission of this new form of electric energy through the public streets, highways, public and private buildings. Naturally they resorted to the practices common in those days in the handling of the comparatively small amount of electrical energy necessary for the transmission of messages, even to the employment of the earth as a part of the circuit. The results that followed these first attempts were not foreseen by them, but soon made themselves manifest in a form not at all agreeable to the fire underwriters and the owners of buildings where the new lights were installed. Bare copper wire fastened with staples to the wall and translating devices similar to those used in telegraphy were resorted to, and in the case of isolated plants the gas piping was utilized for a portion of the circuit. Fortunately the capacity of the early types of dynamos were severely limited compared with the more modern type.

The fire underwriters, ever mindful of the interests of their policy-holders, and very properly of their own as well, were soon face to face with this new and mysterious hazard, which in their opinion was destined to repeat the experience so costly to them due to the introduction of the various forms of oils and burning fluids which had added so much to the "National ash heap" and had so largely increased the population of the "silent cities of the dead." This new hazard was present, and the paramount question was, how to meet it. There were but two remedies: to increase the rates of premiums on buildings equipped with the electric light, or in connection with those engaged in the electric lighting business, to find some way by which the hazard resulting therefrom might be reduced. Happily for both parties and the public in general, the latter plan was adopted, and the first short, crude rules or specifications were drawn up, endorsed by the fire underwriters, and a system of insurance inspection inaugurated which has continued to this day. The first rules have been added to greatly and the electric light has spread out and reached nearly every city.

town and hamlet in the country, necessitating a large and growing corps of inspectors.

This system of inspection is maintained at the expense of many of the fire insurance boards, without in any way adding to the rate of premium of those using the electric light. This is manifestly unfair, and is a burden that should not be borne by the insurance underwriters. Other boards charge a fee for each inspection, to be paid by the contractor, owner of building, or the electric lighting company. So long as the necessity for such inspection exists, it may reasonably be said that such charges are only fair if the rate of premium is not increased.

For some years, a few of the larger cities and later some of the smaller ones have established a system of municipal inspection and supervision of electric construction. In some cases the expense, or a part of it, is paid for by a system of fees for such inspections, while in others the expense is borne by the taxpayers. This system of municipal inspection is being adopted by a good many cities throughout the country. Will it successfully replace that carried on with a great deal of benefit, to say the least, to all classes of the community by the fire underwriters?

There are some well-founded objections to these systems of municipal inspections of electrical construction. I do not claim to speak for the fire underwriters when I point out the fact that in the cities of New York, Chicago and Boston, which have adopted such systems, the underwriters still maintain their own, but in one case at least this is due to the fact that they have not the most implicit faith in the system of municipal inspection. This feeling of mistrust must continue to exist so long as the direction and control of them are given to men, not for their conspicuous ability for such a position, but as a reward for political services rendered to the party that happens to be in power. With every change in the political complexion of the administration in some places comes a change in the heads of these departments, not for the benefit thereof, but for the purpose of rewarding some political worker for the incoming administration; similar changes being made in the working force and for like reasons. Efficiency and possibly honesty cannot be expected under these conditions. It may be said that a few of the most efficient men are retained regardless of their political beliefs or creeds, but it can also be said that these few perform all the duties devolving on these departments, while fifty per cent. of the force could with profit be dispensed with, including the overpaid heads. The political "heelers" with which these departments are filled exercise a demoralizing influence over the entire force, and how can it be otherwise, for those are the ones that are favored by the political "bosses," and unfortunately, they rule our municipalities with a "hand of iron."

In past years, the duties of the municipal electrician have been to care for the fire and police signal service, and any private lines or plants owned by the municipalities. While excellent men in these positions, many of them were not qualified to supervise electrical construction of a widely different character from that to which they were accustomed. In many of the smaller cities these men were called upon, in addition to the performance of their regular duties, to supervise all kinds of electrical construction, and they were placed almost in the same position as the telegraph operators and engineers when the electric light was first introduced. Most of these men of whom I have knowledge have bravely met the conditions imposed upon them by earnestly setting themselves to the task of qualifying for the new duties imposed upon them, and have in the main succeeded. Such men are always to be preferred to the pure and unadulterated politician or "little statesman out of a job," who have no incentive or inclination to qualify themselves for the duties of a position they should never be allowed to occupy. One well-known municipal inspection department since its creation has had four different heads, the original appointment and all subsequent changes having been made for purely political reasons or as the result of corrupt bargains. Not one of them could pass a non-competitive examination for the position of lamp trimmer, and one of them has found his true level in private employ at a salary but little above that paid to laborers in the sewers and on the streets.

Can the important work so well and in the main so satisfactorily done in the past by the fire underwriters be entrusted to municipal departments? To such as just described, the answer must be no; to the first described, yes, providing the door is shut against the political loafers and "dead beats" who seek a resting place in such departments. In most of the towns throughout the country it will be very difficult to inaugurate a system of municipal inspection, owing to the limited amount of work done and the difficulty of procuring a competent inspector.

I think I have already impressed on the minds of our readers the great importance of the work performed by the insurance inspectors in the past, and this work will be no less important when assumed by municipal authorities; and the responsibility of those employed will be no less than those in the employ of the fire underwriters. Owing to the great increase in the use of the electric light, and of electricity for other purposes, the force employed by the fire underwriters is entirely inadequate for the proper inspection of the work being done. Hundreds of miles, possibly thousands, of wire are concealed from view without having ever been passed upon by the inspectors; but this is no fault of theirs, as the force is doing all it can. For this reason municipal inspection is being urged in some quarters, although other reasons less creditable impel some of its advocates. If inspection is necessary certainly the inspection force must be increased; but is it necessary? Great improvements have been made in the methods of generating and transmitting electrical energy since the introduction of the electric light, yet strange to say, if the carefully compiled reports of fires and losses therefrom are to be believed, the number of fires due to electricity and the amount of the annual losses therefrom are steadily increasing, and out of all proportion to the increase in the amount of lighting. Why is this? Let us see if we can find a cause.

Formerly the electric lighting companies did the wiring for their customers free of charge, but that practice has now pretty generally been abandoned and that and nearly all kinds of electrical construction has fallen into the hands of contractors. Through the efforts of these gentlemen the use of electricity for various purposes has greatly increased, owing to their active canvas for business; their numbers have also greatly increased. The man whose electrical experience consists in his ability to string a bell wire hangs out his "shingle" as an electrical contractor, and the electrical "butchers" are as numerous as the "brown tailed moth." With this increase comes a sharp competition for business, and a demand for material that is not approved and does not come up to the standard requirements of the "National Code." Material and devices that are placed on the surface can be examined and if necessary, condemned, by the inspectors at any time, but insulated (?) wire concealed from view cannot be so examined except during the construction of the buildings in which it is placed, and here lies the opportunity for dishonesty. First, owing to the inability of the inspection force to examine all the work done, and next owing to the indifference of the public to the benefits to be derived from good, and the dangers possible due to bad electrical construction, preferring to remain in "blissful ignorance" thereof. For that reason the contracts are awarded to the lowest bidder, regardless of the man who bases his bid on the best material and honest workmanship. It may be asked: Is there much wire manufactured and sold that is below the standard requirements? I will say that I have procured samples from various supply houses that when tested did not come "within gunshot" of it. I will say further that some of them do not keep the standard article in stock, showing the limited demand therefor.

Allowing that a low grade of insulation on wire is suspected, it will take some time to apply the necessary test to determine its worthlessness, and before that time elapses the chances are that it will be concealed from view, and despite the protests of the inspector it will remain. In the course of time, an enterprising local agent will write the insurance on the building, with permission to use electricity for light and power granted, with the flimsy excuse offered, perhaps, that the owner is the innocent victim of a dishonest contractor.

How can all this be prevented? By the combined efforts of the municipal electrician, the fire underwriters, the electric light and power companies, manufacturers of wire and other supplies. Let the insurance companies absolutely refuse to carry insurance on buildings in which the work and materials is not up to the requirements of the "Code." Let the lighting companies refuse to connect their service to such buildings, and go still further back by "blacklisting" all contractors who disregard the best practices known to the art. Let the manufacturers agree to make and sell nothing that is not up to standard requirements; as a matter of fact they can do nothing else after the combined action of the fire underwriters and electric lighting companies here indicated. Let this

measure be taken and taken quickly; then the demand for an increased force of inspectors and municipal supervision will cease; the restrictions imposed on a system of lighting that can be made safer than any other known, and are imposed on but one other, which should be prohibited by the strong hand of the law, will come to an end. If, however, matters be allowed to drift along, there will be involved an increased force of inspectors for which the industry will ultimately have to pay, municipal inspection with all its attendant evils, and a mistrust in the minds of fire underwriters and the public as well.

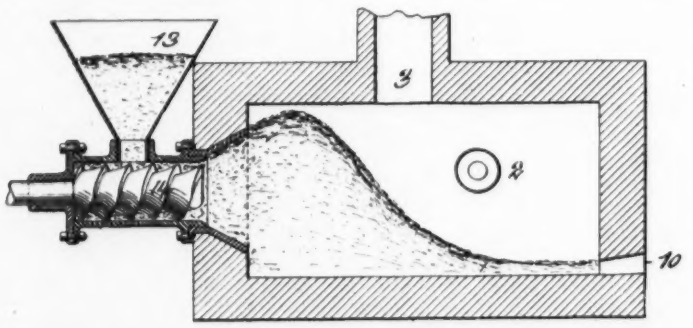
Recent Electrochemical Developments.

ELECTROMETALLURGY OF ZINC.

Electrochemical methods have, up to the present, not found any application on a large scale in the metallurgy of zinc, although a great many inventors have attacked the problem. Most of them have tried "wet methods," a large number of electrolytic processes having been applied on an experimental scale. But so far none has been industrially successful. Th main difficulties are the deposition of the zinc in spongey form and the evolution of hydrogen simultaneously with the deposition of zinc. Any evolution of hydrogen means, of course, a decreased efficiency.

It is peculiar that electro-furnace methods have received relatively scant attention from zinc metallurgists, although the electric furnace has some features which should make its application advantageous for the distillation of zinc. The main point is, of course, that in electric furnaces we are able to concentrate the heat at exactly the point where it is needed, so that it should be possible to get a relatively higher efficiency. On the other hand, in the ordinary metallurgical zinc distillation process there is, as is well known, an enormous waste of fuel, the fuel needed in practice being far more than that required theoretically. It must not be forgotten, however, that the use of an electric furnace means a consumption of electrical energy; that is, of energy in a form which in most cases is quite expensive.

This latter point seems to have retarded the industrial application of the electrical furnace for zinc distillation, although some early experiments were made about twenty years ago, we believe, by the Cowes brothers. Recently C. G. P. De Laval has been interested in the subject and is reported to have used an electric furnace process on a small industrial scale in a plant in Sweden. The construction of his furnace is described in a patent granted to him at a recent



DE LAVAL ELECTRIC FURNACE.

date. It is shown in Fig. 1. The crushed material is placed in the hoppers, 13, and is fed by means of the screw, 14, into the furnace chamber. The electrodes between which the arc is produced are at point 2. The zinc vapors pass up at the outlet, 3, and the crude ore and slag encounter the most intense heat in the arc, while in their thinnest layer on the hearth, and melt and run to the bottom of the furnace, whence they are withdrawn through the opening, 10. It would seem that with the continued decrease in the cost of electrical energy from water power and the increased cost of fuel, such methods are destined to supersede the older processes.

BATTERY EVOLUTION.

T. A. Edison patents a method of rendering gas escaping from his storage battery non-explosive; this method has already been described in these columns.

A. J. Jacobson patents a galvanic battery consisting of a number of dry cells, provided at one end each with an opening capable of being closed by a suitable cover. The rim of the opening is furnished with a suitable insulating means in order to admit of the filling in of the electrolyte shortly before the use of the battery and without effecting any short-circuit by any overflowing electrolyte.

P. J. Kamperdyk patents mechanical details of construction of a primary battery. The cell contains two or more porous cups and passages connecting these cups to allow the liquid therein to flow freely from one to the other, to insure equal density in each.

O. P. Fritchle patents an easily detachable connector for batteries which will resist the action of corrosive liquids and fumes.

New Telephone Patents.

MEANS TO INSURE SECRECY.

Some always have a fear lest telephone communications be overheard by others and used to the detriment of the speaker. Undoubtedly there is considerable cause for this fear, there being a number of cases on record where such has been the case. Mr. Richard M. Beard, of New York, has attempted to improve the situation by the use of circuits such that it is impossible from any manipulation of the keyboard keys of any operator to connect any two pairs of cords together. Furthermore, no operator can "listen in" on her connections without interrupting the circuit. Neither can any two connections be made to a line at the same time, because the jacks are wired upon the old series cut-off system. The arrangement of circuits is quite clever, but the introduction of many contacts in the talking circuits will hardly be looked upon with favor. Mr. Beard has assigned his patent to the International District Telephone Company.

A DOUBLE-ACTING TRANSMITTER.

A new double-acting transmitter has appeared, this the invention of Auguste Gamache, of East Clifton, Canada. The usual scheme of a double induction coil with oppositely poled primaries is employed in connection with a two-part microphone button. This latter is in the form of two cylindrical boxes, with opposed edges clamping between them a ring of mica. This mica carries upon either face a movable electrode, while the bases of the boxes form the other or stationary electrodes. From the diaphragm a metallic spindle is extended through a jacked aperture in the nearer stationary electrode, to the two moving electrodes, to which it is clamped. Both boxes contain granular carbon and as the movable electrode vibrates it compresses one button, while relieving the other.

CENTRAL RINGING SYSTEM.

Under the title "Central Energy System," Messrs. W. M. Kelley and G. E. Truxell, of Greensburg, Pa., have invented an odd local battery magneto system. The hook switch carries a mercury switch wherein a traveling mercury globule following the inclination of the hook makes a series of contacts. One of these is in the middle of its travel and, therefore, always of brief duration. This contact serves to connect a pair of power ringing mains, which extend throughout the system on every wire route, to the subscriber's central office line. This ringing impulse throws the drop. We thus have a system wherein both clearing out and line signals follow the motion of the hook switch, as in a central energy system.

STEP-BY-STEP PARTY LINE SYSTEMS.

There have recently appeared patents for two types of step-by-step party line systems. These involve the usual synchronous switches at the various stations, all responding to current impulse sent out upon the line. Neither system has features which would indicate that it will become of any general importance in the art. The respective inventors are Messrs. B. Brooks and H. F. Metcalf, of Holyoke, Mass., and Mr. H. I. Hawxhurst, of East Oakland, Cal.

SWITCHBOARD CIRCUIT.

Another type of circuit for a full lamp signal common battery switchboard has recently been invented, this the work of Frederick R. Parker, of Chicago. In this system the object seems to be to reduce the number of relays to the lowest limit. One relay for each line serves to control all signals. This relay has two armatures and for proper action must not only work between mechanical limits, but also electrical ones. To explain, at times the current must operate but one armature, while with an increased current it must operate both. Again, both armatures actuate the same spring contact, and while one lifts it half-way to clear an under contact, the other increases the lift to make a second contact. Such apparatus has proved very difficult to adjust in practice, and this difficulty will no doubt weigh heavily against the system.

Electricity Day at the World's Fair.

Each of the exhibit departments has been assigned a day by the Exposition Company to celebrate the advancement in their varied arts and industries. Wednesday, September 14, has been very properly set aside for "Electricity Day," which comes during the sessions of the International Electrical Congress and the several electrical conventions. It is the intention of the Department of Electricity, of which Prof. W. E. Goldsborough is chief, to have special electrical displays and attractions which will appeal both to the electrical engineers and to the general public. The plans now contemplate more elaborate lighting effects about the Grand Basin and Festival Hall and decorative lamps will be placed in trees about the Palace of Electricity. On the north side of the building along the lagoon will be a high-tension line connected to a 100-kw transformer with a secondary potential of 500,000 volts. This will be in operation showing the spectacular effects of high potential discharges.

In the Grand Basin adjoining the Palace of Electricity are to be anchored six floats with special electrical features; for example: One commemorates the twenty-fifth anniversary of the commercial development of the incandescent lamp; one showing a wireless telegraph station; another X-ray phenomena, etc. The Palace of Electricity and the bridges leading to the island will be decorated with flags and special banners. In the evening there is to be an automobile parade. Inside of the building a reception is to be given, to the members of the International Electrical Congress and the visiting electrical engineers.

All the electrical demonstrations are to be repeated September 15, which is St. Louis Day. If all circumstances prove auspicious it is probable that these two days will draw the largest attendance of any similar period during the Exposition.

CURRENT NEWS AND NOTES.

GUATEMALA TELEGRAPHS.—The Guatemalan Government is reported to be considering the advisability of making a considerable extension of its present telephone and telegraph system.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.—The next annual convention of the Interstate Telephone Association of America will be held in Chicago, December 13, 14 and 15 next. Mr. E. M. Coleman, Louisville, Ky., is secretary.

CONVENTION OF NATIONAL ELECTRICAL CONTRACTORS.—The fourth annual convention of the National Electrical Contractors' Association of the United States will be held at St. Louis, September 14-17. The convention train will leave New York at 1 p.m., September 10, and is due at St. Louis at 5 p.m. next day. Delegates from the East can board the convention train at Albany at 4.05 p.m., September 10, the train leaving Boston at 10.45 a.m. the same day. Mr. Alex. Henderson, 527 West Thirty-fourth Street, New York City, is master of transportation.

ST. LOUIS EXPOSITION.—September 10 is Machinery Day at the St. Louis Exposition, when special attention will naturally be concentrated on the Machinery Hall, with its big generating units. On Wednesday, September 14, Electricity Day, will be celebrated. Every exhibitor in the Electricity Building is preparing for that day and there will be water and land parades, with illuminating effects. St. Louis Day follows, September 15. This will probably be the most notable day of the Fair for attendance. To the special attractions which will be provided for its celebration will be added those prepared for Electricity Day, for these will be again shown on St. Louis Day.

CONVENTION OF INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.—The next annual convention of the Independent Telephone Association of the United States of America will be held in St. Louis, September 21, 22 and 23. The headquarters will be at the Inside Inn, at the World's Fair Grounds, and the meetings will be held in the assembly room of the hotel. Daily sessions will be held between 10 a.m. and 1 p.m., thus allowing the delegates the afternoon and evening to see the exhibits. The convention promises to be the most notable gathering of independent telephone men ever held in the United States. Mr. F. G. Jones, 48 West Jackson Boulevard, Chicago, is the secretary.

METERING SYSTEM.—In order to record the total number of revolutions of a plurality of meters by means of a single instrument and thus to determine the entire output of a central station irrespective of the character of the load or of the current furnished, Mr. Thomas Duncan, according to a patent issued August 30, places upon an extension of the shaft of each meter the armature of a small generator whose field strength is kept constant. In any given installation the armatures of the small generators are connected in series with each other and with the armature of a summation meter, the speed of whose disc is proportional to the e.m.f. impressed at the armature terminals. The service meters may be for either continuous or alternating current, or part may be of one kind and part of another, yet the small continuous-current generators serve to totalize the aggregate of the energy recorded by the various meters.

AUTOMATIC SYNCHRONIZER.—To eliminate the uncertainty and difficulty incident to the synchronizing of alternating-current machines by manually operated switches, Mr. Milton C. Canfield, according to a patent issued August 30, proposes to cause the circuit switches to be operated by relay devices placed in action by the machines being synchronized. The invention consists essentially of three parts: First, a phase-responsive device, which closes a contact in a local circuit at the instant of synchronism, regardless of its duration; second, a device which will close a contact in a local circuit shortly before the instant of synchronism, keeping it closed until a short time after the instant of synchronism, but which will thus operate to close the local circuit only when the alternating currents carried by the circuits to be connected in parallel are approaching the condition of synchronism at or slower than a predetermined rate; third, a local circuit with a source of current and an automatic switch operated by it.

MULTIPLE-CONTACT TROLLEY.—The arc which is formed between a trolley wheel and wire indicates that the motor circuit is frequently broken and results in damage to the trolley wheel, the wire and the hangers. A patent issued August 30 to L. M. McBride relates to means for overcoming these disadvantages. The inventor uses a multiple-contact trolley, in which an auxiliary wheel is mounted in the rear of the main wheel, and resiliently supported so as to maintain an equal and independent pressure on the trolley wire, thereby insuring at all times a contact by one wheel or the other. The auxiliary wheel is provided with a spring-controlled swiveling feature and is permitted vertical and lateral motions, thus allowing the auxiliary wheel to stand in planes transverse to the main wheel and facilitating the rounding of curves and the entering of switches.

STARTING RESISTANCE FOR INDUCTION MOTORS.—To Mr. H. S. Meyer has been granted a patent on a method for mechanically locating the auxiliary starting resistance in the secondary circuit of an induction motor, so as to utilize most efficiently the space. The slots of the secondary member are constructed of sufficient depth to provide room below the ordinary phase winding for the auxiliary starting resistance winding. This latter consists of iron wires insulated in a suitable manner from each other and from the main winding. The resistance winding is connected in series with the main winding, and its resistance is graduated in suitable steps, the extremities of each step in each phase being connected to the contacts of a suitable short-circuiting switch, which may be worked either by hand or automatically, and which is arranged to revolve with the rotor, thus avoiding the use of slip rings. The iron wire is intended to serve to conduct part of the useful magnetic flux of the secondary member during the running of the motor. Since, in so far as the increase in torque is concerned, the real object of inserting resistance is to increase the power lost in the secondary circuit to its maximum value by causing the resistance to equal the reactance, the method proposed seems open to the objection of increasing both the resistance and the reactance. The result is that while the secondary current, and therewith the primary current, is decreased the torque is decreased also, the effect being quite similar to decreasing the primary e.m.f.

LETTERS TO THE EDITORS.

Electrical Nomenclature.

To the Editors of Electrical World and Engineer:

SIRS:—The suggestion by Dr. James E. Ives in the issue of ELECTRICAL WORLD AND ENGINEER for August 13, concerning the adoption of the term *rigidance* for the reciprocal of capacity, serves to emphasize the lack of systematic terminology in electrical literature, and draws attention to the fact that no universally accepted terms have been applied to the positive and negative values of reactance. Both $L\omega$ and the reciprocal of $C\omega$ are true reactances, measurable in ohms. To the latter quantity the terms reactance, negative reactance, capacity reactance, condenser reactance, condensive reactance, condensance reactance and condensance have been applied. It would seem that the last term is far preferable to any others which have been used. It will be recalled that such term is employed by Mr. C. P. Steinmetz, not, however, to the exclusion of the other terms.

In regard to the quantity $L\omega$, the proper designating term is doubtless *inductance,* and Mr. Steinmetz, in his "Alternating Current Phenomena," makes certain statements which would lead one to believe that he thus uses the term. In speaking of reactance he states: "If positive, inductance; if negative, condensance," and again: "Series inductance in a condenser circuit, and series condensance in an inductive circuit, cause a rise in pressure," and "ωL_m = mutual inductance." It seems unfortunate that the term *inductance* should have been applied to L, the coefficient of inductance. To this latter fact is, doubtless, due the inconsistent use of the terms inductance, self-inductance and mutual inductance in numerous textbooks and technical articles, in which in some cases it appears to be measurable in ohms, and in others to have the dimensions of henrys.

ITHACA, N. Y. A. S. MCALLISTER.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Induction Motor with High Starting Torque.—BRUNSWICK.—An illustrated description of induction motors designed by Boucherot for use in mines, etc., where a high starting torque is required. The rotor is of the short-circuited type, but consists of two parts, in which e.m.f's are induced by two independent stators. The two parts of the rotor are connected by means of resistances. At the moment of starting the e.m.f's in the two parts of the rotor have a phase difference of 180°, which is gradually diminished until at normal speed phase equality is reached. For regulating the phase difference, Boucherot employs two different methods. For smaller motors, which are easily accessible, the one stator is constructed adjustable around the axle of the machine, and the regulation of the phase difference is obtained by turning the stator in its frame by an angle corresponding to one-half period (i. e., 90° for a four-pole motor, 60° for a six-pole motor, etc.). For larger motors an electric device is used which in its effect is absolutely equivalent to the turning of the stator in the first method. The second method is indicated in Fig. 1. The connections of one stator with the supply

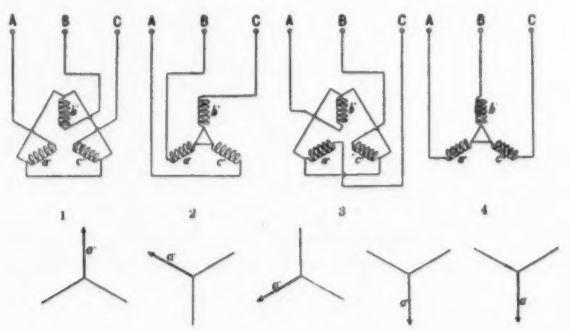


FIG. 1.—WINDING DIAGRAMS.

mains are fixed, while the second stator is connected to the mains by means of a commutator, changing the connections during the period of starting, as shown in the upper diagrams, 1, 2, 3, 4, of Fig. 1. Connection 1 corresponds to the first moment of starting and connection 4 to normal speed. The lower diagrams, 1, 2, 3, 4, in the same figure, show the corresponding direction of the magnetic flux of the stator, which is connected to the commutator, while the fifth diagram represents the direction of the flux of the stator with the fixed connection.—*L'Electrician,* June 18 and July 2.

Breakdown of Electrical Machinery.—An abstract of the report for 1903 of the Engine, Boiler and Employers' Liability Insurance Company, which contains some notes on the breakdown of electrical machinery. The premiums charged for motors driving coal cutters had to be considerably increased, owing to the excessive rate of breakdown of these machines. The annual rate of breakdown among the same has been about one in two. Motors driving underground hauling machines, motors out of doors driving shears, saws and portable tools in iron works, foundries and shipyards are also subject to frequent breakdown. Then come crane motors and so on, until the minimum of risk is reached with the lighting dynamos in a dry and well-appointed room, kept clean and tended by a careful man. The breakdowns of 1903 are classified as follows, the figures giving the percentage of the total breakdowns, the first figure always referring to dynamos, the second to motors: Of the parts of machinery breaking down were armatures or rotors, 62.0 and 50.5 per cent.; magnets or stators, 12.5 and 11.5; commutators or brush gear, 17.0 and 14.5; miscellaneous, 8.5 and 8.5; switch gear in the case of motors, 15.0. As to the causes of damage, there were due to accident, 14.0 and 12.0 per cent.; dirt and oil, 10.0 and 15.5; age and deterioration, 24.0 and 19.0; bad workmanship or design, 17.5 and 18.0; overloading, 3.5 and 5.5; not ascertained, 13.0 and 29.5. Several examples are cited.—Lond. *Elec.,* August 19.

REFERENCES.

Diagram of Induction Motor.—BETHENOD.—A mathematical article in which the author shows how it is possible by purely geometrical methods to obtain an exact diagram for the induction motor, the primary ohmic resistance being strictly taken into account. The ordinary Behrend-Blondel-Heyland diagram is a special case of the general diagram of the author.—*L'Eclairage Elec.,* August 13 and 20.

Separating the Different Losses in Direct-Current Dynamos.—CRAMER.—A description of a method in which two curves are made use of. One is the relation between the voltage at the terminals and the no-load power at constant speed, the other the relation between no-load current and voltage at the terminals. Th separation of the different losses is based on the rule that the no-load current is a minimum when the friction loss equals the eddy current loss plus 60 per cent. of the hysteresis loss.—*Elek. Zeit.,* August 18.

Single-Phase Motor.—ELIHU THOMSON.—A reply to Goldschmidt stating that the essential points of the Crompton single-phase motor are found in his early patents for the repulsion motor.—Lond. *Elec.,* August 19.

LIGHTS AND LIGHTING.

Vacuum Tube Lighting.—MOORE.—An illustrated article giving some historical notes on the development of vacuum tube lighting. He thinks that mercury will not figure in the final solution of the problem, because its spectrum is entirely devoid of red rays. Vacuum tubes of the future should be capable of being operated by alternating currents. The problem is to find a gaseous conductor capable of giving a light of high intensity, of high efficiency, of long life, and of daylight color values. The principal reason why a high efficiency should be obtained with a vacuum tube is that the proportion of the visible radiation to the total radiation depends largely on the chemical constituents of the gaseous conductor, and not as with solids, like the incandescent lamp filament, upon the temperature. The

goal to strive for is the reproduction of daylight, not direct sunlight, but diffused daylight. This is approached by a 2-in. tube, 43 ft. long, bent back and forth upon itself in a horizontal plane, and thus forming an artificial skylight; such a tube is stated to have been in continual use for six months. Some diagrams are given showing the connection of the tube to the alternating-current mains.—*Cassier's Mag.*, September.

REFERENCE.

Electric Lighting of Gas Lamps.—An illustrated description of mechanical details of construction of an electric device for lighting gas lamps from a distance.—*Zeit. f. Beleucht.*, August 20.

POWER.

Electric Equipment of Workshops and Electric Heating.—MOSES.—An article on the electric equipment of workshops and factory buildings. In one of the largest printing offices in the United States the results have been tabulated and show that over 20 per cent. more work was obtained from a given set of operators and machines with the direct-connected electric motor equipment than with the old countershaft method. The result is due largely to the ability to adjust each piece of apparatus readily, both as to the machine itself and to the operator. The ability to control and regulate the operation of the apparatus at a distance by simple push buttons or switches is another advantage. The use of electricity for heating is uneconomical, since rarely more than 5 or 6 per cent. of the heat energy in coal can be converted into electric energy; but the author thinks that as gas has replaced coal for localized high temperature purposes, electricity is in turn replacing gas. In general it is cheaper to heat by electricity than by gas where electricity is supplied by a private plant for other purposes and the whole or part of the exhaust steam from the engine can be used. This has a great deal to do with its introduction in large hat factories, where great quantities of low-pressure steam are required for other purposes. Frequently in smaller plants the electric heating serves merely to raise the average load of the engine during the day run, and the increasing coal required is not in proportion to the increase in energy supplied. Almost all modern hat factories are equipped with heating apparatus for ironing, glue kettles and dozens of special applications. Printing offices are using electric heating apparatus in a great variety of ways. Where a high rate of heat emission per square inch is desired, with results similar to those from direct gas flames or Bunsen burners, low electric pressure must be used so that the resistance wires may be close together, the insulating light and the amount of current for a given quantity of energy comparatively heavy. Where a low rate of heat emission is needed the voltage may be higher, but in no case should it exceed 120 or 130 volts. In designing the equipment for a factory or manufacturing plant it is advisable that the electricity for lighting and the electricity for power shall be supplied from different mains controlled by different switches on the switchboard. The author speaks briefly concerning the different direct and alternating-current systems.—*Eng. Mag.*, September.

REFERENCE.

Electrical Power for Irrigation.—WALSH.—A short article on the advantages of electricity for pumping water for irrigation. In the West electricity is usually obtained by tapping the long-distance transmission lines through transformers. Between Los Angeles and the Sierra Madre Mountains, from which the power is drawn, there are upward of 600 electric pumps now in active opertion.—*Am. Elec.*, August.

TRACTION.

Power Supply to Tramways in North London.—A continuation of the illustrated description of the Brinsdown power station of the Metropolitan Electric Power Supply Company. The engine room contains three 1,000-kw turbo-generator sets, there being room for a fourth. The steam turbines are of Parsons' standard design and run at 1,500 r.p.m. Directly coupled to each turbine, and resting on the same bedplate is one 1,000-kw, three-phase generator, the voltage being 10,000 to 11,000, between only two stator windings. It is noteworthy that the generator is of the revolving-field type, as at the high speed in question, considerations with regard to balancing and mechanical strength of the magnet poles are very important. Since the frequency is 50 periods per second, the dynamo has four poles. These consist of laminated iron sheets of special quality, and the magnet windings of copper wire of 100 per cent. conductivity (Matthiessen's standard) are embedded in slots milled in the core, metal wedges being employed to prevent the windings from flying outward owing to the centrifugal forces. Those parts of the winding which overhang the core are protected by heavy metal caps. The exciting current is taken from the 110-volt circuit of the station and is led to the rotating magnets by way of two steel slip rings and suitable brass brushes. At full load and with a power factor of 0.85, the exciting current is specified not to exceed 115 amp. Each turbine has its own surface condenser. The plant of the engine room comprises, in addition to the turbo-generators, four steam exciter sets, two of 50 kw each and two of 100 kw each. In addition to supplying the exciting current for the alternators, they produce the energy for running the auxiliary motors in the station and for operating the lighting system of the building. There is also a booster for the storage battery.—Lond. *Elec.*, August 19.

REFERENCES.

Industrial Locomotives.—GAIRNS.—The third of the series of articles on industrial locomotives for mining, factory and allied uses. The present article deals with electric locomotives and gives an illustrated description of the various types, especially of European manufacture.—*Cassier's Mag.*, September.

Subway.—FYFE.—A fully-illustrated article on the history, construction, equipment and power plant of the New York Rapid Transit Subway.—*Eng. Mag.*, September.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

REFERENCES.

Controllers.—EDLER.—The first part of an illustrated article on the design of controllers for heavy hoisting and hauling machines. He describes the design of a controller for a series motor with regulation of speed by weakening the field and that of a controller for a series crane motor.—*Zeit. f. Elek.* (Vienna), August 21.

Switch Gear.—An illustrated description of a form of the cellular pattern of switch gear designed by an English company for single-phase systems at 2,000 to 3,000 volts.—Lond. *Elec.*, August 19.

Long-Distance Switches.—LINDENSTRUTH AND FORSTER.—An illustrated English translation of the German article recently noticed in the Digest.—Lond. *Elec. Eng.*, August 19.

WIRES, WIRING AND CONDUITS.

Bare Underground Mains.—An illustrated description of the "simplified" solid system of laying bare underground mains. The troughs, which are of sound red pitch pine, are laid in the trench, porcelain bearers or bridges are spaced at short intervals therein and bare-stranded conductors are placed on and securely wedged into them. A material, called carbolite, is then run into the trough so as to cover entirely the conductors; an inner lid of wood is placed in position and the whole is finished off with a continuous cover of carbolitic asphalt. For carbolite, the composition of which is not given, it is claimed that it possesses all the essential characteristics for the ideal compound. It surrounds thoroughly the bare metal conductor, so that the whole mass is homogeneous. The compound is stated to be absolutely indifferent to chemical action, not liable to crack and to have a high specific insulation resistance. It does not break down at a high pressure. It is stated that a length of a low-tension main has recently been subjected to an alternating-current difference of potential between conductors of 20,300 volts for 10 minutes, without showing any signs of breaking down.—*Lond. Elec.*, August 19.

REFERENCE.

Fire-Proof Insulated Wire.—An illustrated note on fire-proof insulated wire, which is surrounded by asbestos in its fibrous form, and is then treated with cement.—*St. R'y Jour.*, August 13.

ELECTRO-PHYSICS AND MAGNETISM.

Electron Theory.—DRUDE.—An abstract of a paper on optics and the electron theory. He adopts Thomson's view that metallic conduction is due to negative electrons only. He deduces another independent value of the ratio of the electronic charge to its mass, the basis being the Ketteler-Helmholtz dispersion formula. It comes out as 15,500,000, whereas the standard value from other methods is 18,600,000, which is close agreement, as methods go. Applications are made to electrochemistry and Drude shows that cations contain a number of electrons separated into two distinct groups, one group being loosely held and the other firmly attached to the atom. The former are never in excess of valency and they determine conduction

and dispersion. The more closely connected ones have a very much higher frequency of oscillation, and one cannot but connect this fact with the high frequency of the new N-ray oscillations. Intermediate degrees of mobility exist in metals which, like iron, exhibit various valencies at different times. Anions, on the other hand, may possess a large excess of negative electrons loosely held. He has determined the number of free electrons in the molecules of 72 chemical compounds and finds, for instance, that in water the number of electrons is just four, equal to the sum of the valencies of the atoms. —Lond. *Elec.*, August 19.—DRUDE'S original paper is published in *Annalen der Physik*, No. 9.

REFERENCE.

Alternating-Current Theory.—SPIELMANN.—A mathematical paper on the calculation of alternating-current phenomena without assuming a constant coefficient of self-induction. The latter assumption may lead to erroneous results if there are nearly saturated iron masses present, or if the e.m.f. wave contains higher harmonics of large amplitude. The author gives a mathematical solution of the problem to give in form of a Fourier series the current in a circuit containing an inductance coil with an iron core, the latter being part of a magnetic circuit that can be calculated with sufficient exactness. —*Zeit. f. Elek.* (Vienna), August 14.

ELECTRO-CHEMISTRY AND BATTERIES.

Resistance Furnace.—FITZGERALD.—An illustrated exposition of some fundamental principles of electric resistance furnaces. He first gives the conclusions which follow from Ohm's law and Joule's law and then discusses the distribution of heat from an electric resistance rod in which electrical energy is changed into heat, and from which the heat is distributed to the surrounding medium. He gives several equations which are useful in determining the dimensions of a furnace for a given purpose. The great value of the use of the electric furnace for many purposes lies in the high temperature obtainable, thus permitting the attainment of temperatures that could not possibly be obtained with other means. He then gives the principles of the design of such furnaces in which the current is passed directly through the material under treatment. It is frequently the custom to speak of using a certain current density in furnaces of this kind, but this is an objectionable practice unless the electrical resistivity of the material through which the current passes is also given. Since the same material at different temperatures has different values for its electrical resistivity, the proper data to give in all cases are the watts per unit volume. Efficient heat insulation is of the greatest importance for electric furnaces, and even if it involves considerable first cost, it will save money in the end, since it saves the expenditure of the electrical energy.—*Electrochem. Ind.*, September.

Electrolytic Chlorine.—WINTELER.—An article stating that on account of the overproduction of chloride of lime from electrolytic alkali plants, the price of bleaching powder has gone down to such an extent that there is scarcely any profit in its manufacture. The author suggests that only part of the chlorine should be used for bleaching powder and the balance be utilized for making other valuable products. He gives brief instructions for the manufacture of a number of the same. After mentioning some precautions which must be taken in the manufacture of bleaching powder, he discusses the detinning of tinned iron scrap (tin cans) for the manufacture of tin tetrachloride. This is used for the manufacture of pink salt, which is extensively employed in cotton printing and silk dyeing. He then describes the production of chloride of sulphur (used in the rubber industries for vulcanizing), and of various chlorides of phosphorus, also the production of a lead peroxide paste used in dyestuff factories. The uses of electrolytic chlorine should, however, not be restricted to the production of inorganic compounds and the author thinks that electrolytic alkali works might become the center of industrial process of organic chemistry in this country. The author describes the production of the following compounds: Acetic acid, anhydride, chloroform, chloral, dichloracetic acid, methylene chloride, monochloracetic acid, trichloracetic acid, etylene chloride, monochlorbenzene, paradichlorbenzene, paradichloraniline, benzalchloride and metachlorbenzaldehyde.—*Electrochem. Ind.*, September.

REFERENCES.

Ionic Transport in Fused Salts.—LORENZ AND FAUSTL.—An account of experiments in which Hittorf's transport number of ions was determined for mixtures of fused salts. If a mixture of potassium chloride and lead chloride in equivalent quantities is electrolyzed at 800° C., the lead is part of the anion, while the potassium is cation and has a transport number of about 0.3.—*Zeit. f. Elektrochemie*, August 19.

Zinc and Lead from Complex Sulphide Ores.—BURLEIGH.—An account of a new process which he has tried on a large scale for the electrolytic production of zinc and lead from complex sulphide ores. The process consists of six stages: Crushing, roasting, extracting by means of a soda solution, filtering, electrolytic deposition of lead and the electrolytic deposition of zinc. The different stages are described in some detail.—*Electrochem. Ind.*, September.

Contact Process.—An article giving historical notes on the development of the contact process for making sulphuric acid and giving some details of the methods used in various plants in this country on a large scale. In an editorial the question is discussed how catalytic action could be used to influence electrolytic processes.—*Electrochem. Ind.*, September.

Biographical.—A biographical sketch, with portrait, of William H. Nichols, president of the General Chemical Company and of the Nichols electrolytic copper refinery.—*Electrochem. Ind.*, September.

Artificial Graphite.—JOHNSON.—An illustrated article describing various apparati which are useful for metallurgical work, and which can be easily made from artificial graphite.—*Electrochem. Ind.*, September.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Mercury Thermal Ammeter.—CAMICHEL.—A description of a thermal ammeter in which the wire is replaced by a thread of mercury. A mercury resistance is placed in the interior of the reservoir of a mercury thermometer, and constant current is made to traverse it for one minute. The ammeter thus constituted is placed inside an enclosure maintained at the temperature of melting ice. The increase in length of the thread of mercury measures the current. The instrument is graduated from another ammeter, the curve being very nearly a parabola. To avoid delay in the cooling down of the mercury, the reservoir is placed over another whose level can be raised by plunging a block of iron into it. The mercury thus raised surrounds the thermometer reservoir and quickly cools it down to the zero position, and the plunger is raised. In one of the models constructed, a current of 10 milliamperes displaces the thread by two divisions. The usual precautions taken in the case of barometer tubes must be observed. Instead of sending the current through for one minute, it is possible to continue the current until a stationary condition is attained. This is, however, advisable only in the case of long-continued currents, as the time required to attain a steady value is about 20 minutes.—*Comptes Rendus*, August 1; abstracted in Lond. *Elec.*, August 19.

REFERENCE.

Condensers.—MONTPELLIER.—An article giving some notes on the construction of commercial electric condensers.—*L'Electricien*, July 9 and 16.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Tuned Wireless Telegraph Transmitter.—SLABY.—A very long illustrated "first paper" on the methods of tuning wireless telegraphy transmitters to a certain wave length without varying the length of the vertical wire. He first makes some remarks on the capacity and self-induction of a straight wire for quick oscillations. The energy capacity of a transmitter wire is not unlimited, but there are two methods of increasing it. First, it is possible to cover the wire with an insulating material of great delectric strength. A wire of 1 mm. copper core with 0.5 mm. rubber insulation loses 14 per cent. of its capacity if the insulation is removed. Further, it is well known that in a moist atmosphere the action into the distance from a bare Marconi wire is greater than in dry air with sunshine. While the ionization of dry air has surely a detrimental effect on the transmission, it is quite possible that the high delectric constant of moist air, which increases the energy capacity of the wire, may play a part in improving transmission. A second means of increasing the energy capacity of a transmitting station consists in using various transmitter wires in parallel either in harp or in cone form or by using surface capacities at the terminal of the wire. The author first discusses the original Marconi transmitting arrangement. He deals with the question whether the connection to earth of the transmitting system may be

replaced by the connection to the other end of the air-gap (instead of with earth), with a wire of a length which is in an odd multiple of the length of the vertical wire. He shows that earthing is preferable under all circumstances. He then describes how to calibrate the "multiplication rod," which is used by him for measuring wave lengths. He then deals with the theory of the action of the Marconi transmitter into the distance. He asks whether the electric or the magnetic lines of force are more important for the transmission. Experiments made by him confirm Maxwell's theory that the electric action into the distance decreases with the cube of the distance, while the magnetic decreases simply proportionally with the distance. The transmitter should be placed in such a way that the lines of force starting from the point of maximum current are propagated with as few obstacles as possible. Any vertical conductors in the neighborhood act as obstacles. On land the transmitter should be placed on a hill if possible. Of great importance is a good earth connection; on warships the transmitter should be connected to the iron hull. He then shows that transmitters using various vertical wires in harp or cone form permit an increase of capacity and of the distance of transmission within very wide limits. There is practically no limit if it is possible to increase the wires at will and if the plant for generating the energy for charging is sufficiently large. The Marconi transmitter can be tuned to a certain wave length without changing the length of the vertical wire by inserting coils of wire between the air-gap on the vertical wire. This method is discussed at some length. The author finally deals with a method of using a surface capacity near the terminal of the vertical wire by means of which the action into the distance may be increased to a limited extent.—*Elek. Zeit.*, August 18.

Electrocapillary Recorder.—An illustrated description of the Orling-Armstrong electrocapillary recorder for cable telegraphy. Like a relay of the same inventor's, it is based on the principle of the Lippmann electrometer, its action depending on the change of surface tension at the bounding surface between mercury and dilute sulphuric acid when a difference of potential is established. In the relay this change was utilized to cause the mercury to flow out of a capillary tube actuating a mechanical device directly, or closing an electric circuit which produces a similar result. In the record, however, the mercury never flows out of the capillary tube, but simply moves in the same, like in the Lippmann electrometer. In Fig. 2 *T* is the tube connecting the mercury column and ends in a fine capillary extension under the surface of the dilute sulphuric acid; the capillary portion is bent at a right angle to the tube, and the bounding surface between the two liquids is at the middle of the length of the horizontal portion. If a difference of potential is established between the mercury in the capillary tube and the mercury on which the sulphuric acid rests, the mercury in the horizontal capillary tube moves instantaneously. By means of a suitable projection apparatus the magnified image of the thread of mercury is thrown upon a traveling sensitive tape, so that a record of the movements of the mercury is obtained which is at the same time a record of the varying potential difference impressed upon the instrument. The additional tubes shown at the right hand in the illustration are intended merely to adjust the position of the mercury thread of the capillary tube. Practically no current flows through the instrument since the action is due to polarization at the surface of the electrolyte; hence an infinitesimal amount of power is required for operation. The instrument is stated to be exceedingly sensitive. A speed of 360 words per minute is stated to have been obtained with this instrument in connection with a Wheatstone transmitter in telegraphing from London via Glasgow and Edinburgh to London.—Lond. *Elec. Rev.*, August 19.

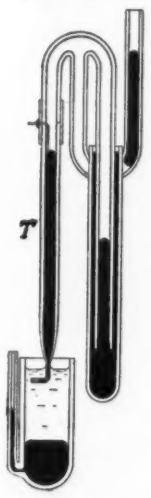


FIG. 2.—ELECTRO-CAPILLARY RECORDER.

MISCELLANEOUS.

British Association Meeting.—A brief account of the opening of the seventy-fourth meeting of the British Association for Advancement of Science, at Cambridge. The attendance reached the unprecedented figure of 2,700. Balfour's presidential address was "an epic telling of the great deeds of the English heroes in the field of intra-atomic physics." Parsons' presidential address before the engineering section was a plea for better treatment of the British inventor. He urged that invention should be stimulated as much as possible by adequate protection, and that when the commercial development of an invention is likely to require some considerable time, it would be highly desirable that it should be taken into account in granting the patent, if the practical difficulties in the way of such a system are not insufferable. He suggests that the conditions under which patents are granted should be analogous to those governing the formation of gas, electric light and other companies.—Lond. *Elec.*, August 19.—The full presidential address of Balfour is printed under the title, "Reflections Suggested by the New Theory of Matter," in *Science*, August 26, and Lond. *Elec.*, August 19. Parsons' address on the patent system and the first part of Lamb's presidential address to the Mathematical and Physical Section, are reprinted in Lond. *Elec.*, August 19.

Mathematics in Engineering.—REID.—The author considers mathematics as a sort of "shorthand reasoning." In original investigation, when an engineering result is reached by mathematical analysis, the only safe way to avoid errors is to refer back every important equation to the physical facts it represents. The methods of mathematical analysis are a powerful instrument for directing the mind into the correct line of reasoning; and when reasoning, following the steps of the analysis, has shown it to be correct, the final equations can be used to furnish exact numerical values or quantitative laws. But it is necessary to bear in mind that even with the use of every available aid toward the predetermination of final results, it is almost impossible in original work to think of and allow for the effect of every factor that may enter the problem and affect the final result. In the case of the application of an equation which has been previously found reliable, it is necessary that its method of derivation and the assumptions on which it is based be perfectly understood. In engineering the processes of mathematics are not to be used to supplant the reasoning of the engineer, his common sense and his trained judgment, but to aid these by broadening his resources and increasing the accuracy of his knowledge.—*Cassier's Mag.*, September.

REFERENCE.

Manufacturing Plant.—The first part of a fully illustrated description of the new plant of Siemens Bros. & Co., at Stafford, for the manufacture of direct-current dynamos, alternators, transformers, switch gear, etc.—Lond. *Elec. Rev.*, August 19.

New Books.

FOWLER'S MECHANICAL ENGINEER'S POCKET BOOK. 1904. Edited by William H. Fowler. Manchester: Scientific Publishing Company. 441 pages. Price, red edges, 1s. 6d.; gilt edges, 2s. 6d.

The leatherette binding of this volume is not beautiful or durable, but considering the merits of the contents and the extremely low price, one is not disposed to be critical. The book, while containing some matter usually found in engineers' pocket books—such as a very good table of the properties of saturated steam—contains much matter that the reviewer has never before seen in a pocket book. For example, a table of data on spiral springs and another on plate springs. There is a large amount of useful information in this little book, information regarding steam engines, gas engines, fuel combustion, iron and steel, machine shop practice, lubricating oils, electric cranes, etc., all in a remarkably compact form. Unlike most of the modern "pocket books," this book can be really carried in the pocket—even in a pocket not especially constructed for the purpose.

MOODY'S MANUAL OF CORPORATION SECURITIES, 1904. 2464 pages. Moody Publishing Company, New York City. Price, $10.

The tendency to throw every industry and well nigh every business or firm into the corporate form renders this manual an absolute necessity, and the data it contains are invaluable. It contains the statements as far as obtainable of over 11,000 corporations. It contains the addresses of 4,500 brokers and financiers, 24 stock exchanges, list of absorbed corporations and an index to cities as well as companies, taking up 284 pages; governmental securities, 31 pages; steam railroads, 377 pages; gas and electric light companies, 172 pages; electric railways, 261 pages; water supply, 22 pages; telephone, telegraph and cable companies, 51 pages; industrial and miscellaneous, 447 pages; mines and oil companies, 82 pages; banks and insurance, 541 pages; later information, 80 pages. Such a volume would be more valuable if it could give operating data and the quotations of the securities in the market, or when last dealt in. As it is, however, the volume is most welcome.

The Turbo-Electric Power System in Paint Manufacture.

An unfailing accompaniment of business prosperity is the gradual enlargement of industries affected, and in almost every case the adoption of more modern and more efficient systems tending to reduce the works costs of the particular product manufactured. An excellent illustration of this point is offered by the Cleveland plant of the Sherwin-Williams Company. There are very few concerns in any line of business that have made such marked headway in such a comparatively short time. From the small beginning of a store building in 1886, the company now operates what is said to be the largest system of paint and varnish factories and warehouses in the world, with four large factories in Cleveland, Chicago, Montreal and Newark, and offices and warehouses in New York, Boston, Kansas City, San Francisco, Los Angeles, San Diego, Minneapolis, Toronto and Winnipeg; and a European department, with headquarters in London. A fair idea of the rapid advancement of the company may be gleaned from the fact that the natural increase in business during the years of 1902 and 1903 equalled the entire business in 1898.

The success of the company may be attributed to a constant endeavor to keep abreast of the times in everything that pertains to the business. There is the keenest desire on the part of the management to maintain the entire organization at the highest standard. In no part of the business is this more apparent than in the power equipment. The company has a wide reputation for up-to-date power facilities.

Among the more progressive steps in the development of the power equipment of the company has been the adoption of the polyphase system of electric drive with steam turbines as prime-movers. The causes which led up to this action may be of interest. Up to 1901 a central plant had been in operation equipped with the non-condensing Corliss engines belted to line shafting in the adjacent building. The remaining power requirements were met by operating at various points non-condensing steam engines and pumps. The enormous waste attendant upon this system of power production and its lack of flexibility to accommodate additions to the manufacturing plant led to the adoption, in 1901, of electrical drive throughout the premises. The central station was retained and converted into an electro-generating plant employing Westinghouse two-phase, compensated-field generators, driven by a slow-speed Corliss and a high-speed compound automatic engine.

In 1903 the demand for more power had become so urgent that further extensions were necessary, although the station at the time was much crowded. In this dilemma the steam turbine came to the rescue, and a 400-kw Westinghouse-Parsons generating unit, together with its entire condensing equipment, now stands in the place left vacant by a 160-hp engine-driven unit (see Fig. 1). The turbine unit was set in position, connected up to steam and electrical systems, and was delivering power to the switchboard within two days from the time the foundation made vacant by the removal of the old engine had been prepared for it—three and one-half days, including Sunday, being consumed in the entire operation of conversion. This is a remarkable instance of the facility with which a turbine plant can be put into service on short notice where the stoppage of a manufacturing plant would result in considerable pecuniary loss, not considering the delays in fulfilling orders. The turbine at first was operated non-condensing until the condensing equipment could be put in place.

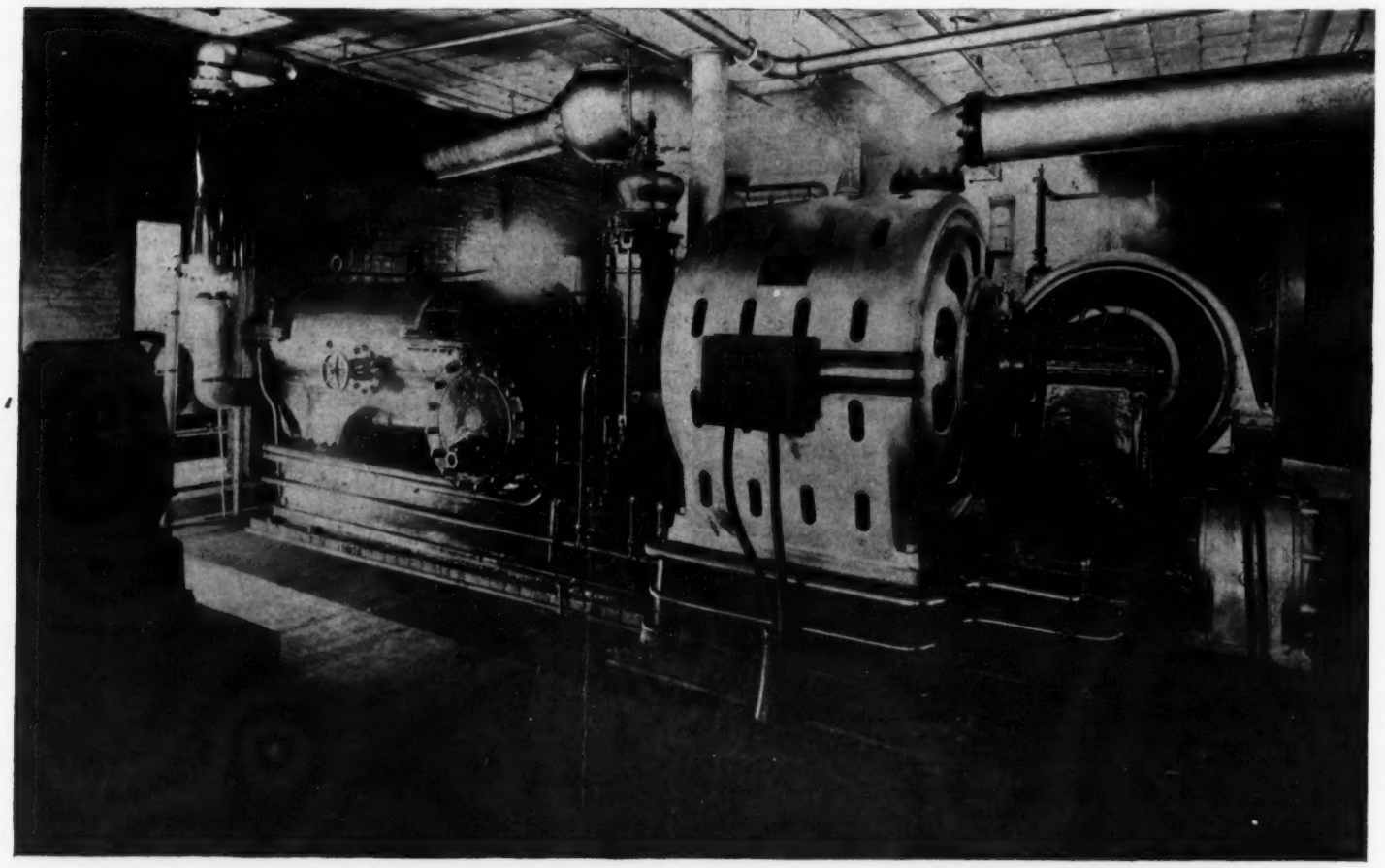


FIG. 1.—400-KW WESTINGHOUSE-PARSONS GENERATING UNITS.

Perhaps the most striking feature of the turbine plant is the ease with which the steam turbine has been made to accommodate itself to existing conditions and the confidence which has already been aroused among plant attendants during its five months' operation. It is at present depended upon to carry the entire load of the manufacturing plant, in which are several 100-hp polyphase motors and three electric elevators; also to furnish lighting for all buildings. A 150-kw and a 75-kw, two-phase, direct-connected unit at present supplement the turbine plant, but as soon as the load demands further increase the latter will be replaced by a second turbine unit. The space occupied by the turbine set with its auxiliaries is 15 ft. x 38½ ft., or 1.44 sq. ft. per electrical hp capacity. With the exception of the dry air pump, all the apparatus is installed in a pit 6 ft. in depth, covered with open iron grating.

The turbine unit rests upon the old engine piers, which had been flushed off with concrete for this purpose. No foundation bolts are used. It receives steam from above, the inlet being protected by a strainer of perforated metal sheet stationed between throttle

and inlet valve. As usual, an oil-cooling coil located in the base plate is used to remove from the oil returning from the several journals the heat generated through fluid friction of the oil films. This cooling water is, however, not wasted, but is passed successively through the air compressor jackets, a cooling coil in a water still, and thence into the boiler feed suction.

The condenser is of the Worthington high-vacuum surface type containing approximately 1,500 sq. ft. of cooling surface. It is practically piped direct to the turbine exhaust, only a corrugated copper expansion joint and a tee intervening. There is inserted in the water line a tubular vapor cooler, which serves to arrest all the condensible vapor as it is drawn from the top of the hot well through the cooler by the dry air pump; this condensation water then returning to the hot well. All the water collecting in the hot well is returned to the boilers by a 5¼ x 4¾ x 5-in. duplex steam pump automatically controlled by a float in the condenser hot well.

Cooling water is handled entirely by an 8-in. Worthington centrifugal pump driven by a 10-hp type C motor, located upon the floor level. Both suction and delivery pipes are water-sealed beneath the water level of a canal running parallel to the plant. The work done by the motor is, therefore, practically constant and used entirely to overcome fluid friction in the condenser and piping. It has been frequently advanced that variable-speed auxiliaries are highly desirable in securing the most economical results from a condensing plant. In this instance, however, the power consumed by operating the circulating pump at practically constant speed is such a small proportion of the total power required, and the advantages of the highest vacuum at all times so great, that it was not considered necessary to install a variable-speed motor which would require more or less attention.

The dry air pump is of the Worthington rotative single-stage type, 8 in. x 13 in. x 8 in., running non-condensing. A 14-in. atmospheric exhaust rising directly from the condenser tee provides relief in case of lost vacuum. With this equipment there is readily maintained an average vacuum of 27½-in. gauge, which is equivalent to 28.25 in. referred to a 30-in. barometer.

Steam is supplied to the turbine at a pressure of about 135 pounds. It is approximately dry, two separators securing this result; one a 14-in. Cochrane located in the boiler room directly in the steam line, and the other a vertical "direct" separator at the turbine throttle. The steam is generated by a 500-hp battery of Stirling boilers, an auxiliary 240-hp battery of horizontal return tubular boilers serving to supply low-pressure steam for various purposes throughout the factories.

An interesting example of utilization of waste heat from products of combustion has here been worked out with success. Two steam-driven suction fans are installed in an addition to the boiler room. One fan draws ventilating air surcharged with vapors from the paint-mixing room through a tubular air heater, thence forcing it into the furnaces of the several boilers. The other fan draws the products of combustion from the boiler breeching through the tubes of the air heater, delivering it into the stack. With this arrangement a separate ventilating fan is avoided and considerable heat is extracted from exhaust gases. Under normal conditions a difference in temperature of 150° is observed between the two ends of the smoke flues, and the air is heated through an average of 150° F. The heater is constructed of sheet iron in the form of a closed water heater and has an effective heating surface of approximately 3,000 sq. ft.

All exhaust steam from power plant auxiliaries is made use of, including steam from air pump, air compressors, fire pump and fan engines. Most of it is turned into a 1,000-hp Cochrane open heater, but during cold weather some of the exhaust steam is directed into the heating system of the building, the remaining steam being supplied by live steam from the low-pressure boilers. In the severest weather the turbine will be operated non-condensing and its exhaust steam utilized in the heating system. As the Webster suction system is in use, the back pressure of the turbine will be reduced to a minimum, usually about one pound. About 25,000 sq. ft. of direct heating surface are required to heat the various buildings during cold weather.

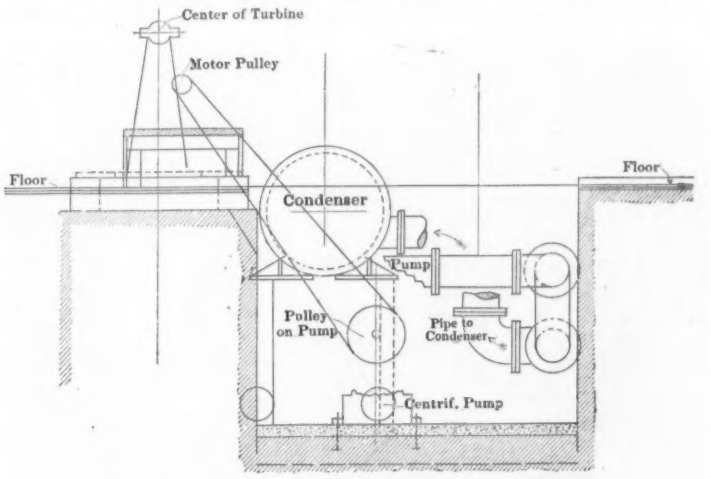


FIG. 3.—ELEVATION OF CONDENSER EQUIPMENT.

On account of the few months the turbine plant has been in operation, it is difficult to obtain accurate and conclusive figures of economy. There has, however, been observed a noticeable decrease in the cost of power, which will be further emphasized with increasing load. Economy tests of the turbine have been conducted both at the builders' works and in the plant. In the former tests a water consumption per electrical horse-power-hour of 11.86 pounds was obtained at 8 per cent. overload, and 13.2 pounds at half load, this with 150 pounds steam pressure, 28-in. vacuum (referred to 30-in. barometer) and an average of 145° superheat. The following acceptance tests were conducted by the chief engineer of the company, Mr. F. W. Ballard, during the regular daily runs, under service conditions:

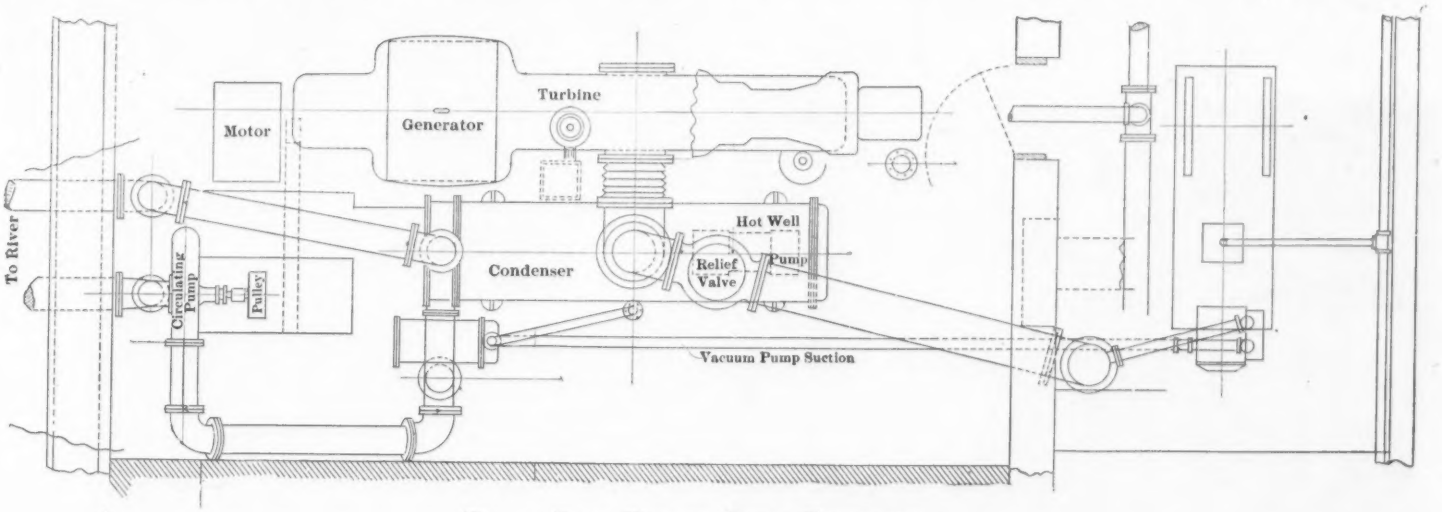


FIG. 2.—PLAN VIEW OF POWER EQUIPMENT.

Acceptance test, March 21, 1904.—Length of run, 2 hours; average steam pressure, 131 pounds; average vacuum, 27¾ in.; average load, 250 kw; total water, 11,060 pounds; water per kw-hour, 22.12 pounds; water per electrical hp-hour, 16.59 pounds; guarantee, 17.8.

March 22, 1904.—Average steam pressure, 129 pounds; average vacuum, 27½ in.; average load, 300 kw; total water (2 hours), 11,190

pounds; water per kw-hour, 18.65 pounds; water per electrical hp-hour, 14 pounds; guarantee, 16.7.

The amount of water was determined by weighing the condensation, and the load by observing the switchboard instrument, which were previously checked with standard meters. Assuming an average evaporation of 7 pounds of water per pound of coal, the coal consumption of the plant figures out 2.66 pounds at full load and 3.16 pounds at half load.

There is in force in the Cleveland plant a simple and effective method for distributing power costs among the various departments. Polyphase integrating wattmeters are installed in each of the service

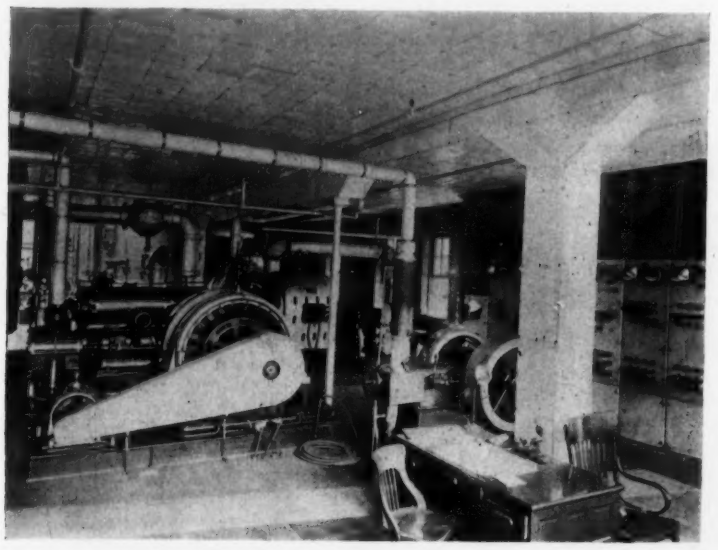


FIG. 4.—GENERAL VIEW OF GENERATING EQUIPMENT.

feeders in the sixteen different departments in the works. The cost of power at the power house switchboard is then charged against the several departments in proportion to the power consumption indicated by their meters. This system, while not taking directly into account the variations in distribution losses between the power plant and the several departments, nevertheless distributes them pro rata. These distribution losses were found under test to vary from 5 per cent. to 10 per cent., according to the duration and value of the load upon the feeders in question. The cost of power at the main switchboard comprises coal, oil, waste, labor, general sup-

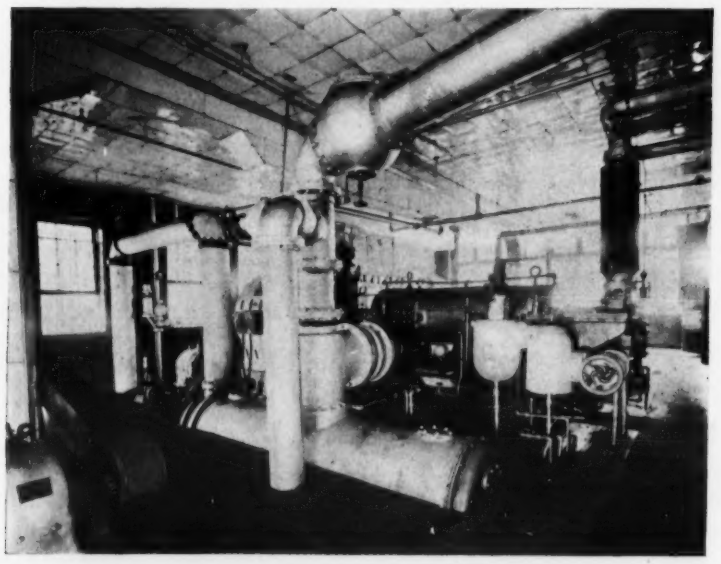


FIG. 5.—TURBINE AND CONDENSER.

plies and maintenance of apparatus, no fixed charges being included, as it would be difficult to segregate these from factory investments.

All power and lighting circuits are controlled from the power house switchboard, a nine-panel Westinghouse two-phase board equipped with duplicate buses and double-throw switches. The load is comparatively uniform, due to the use of a large number of motors which run under nearly constant load. At present the connected motor capacity totals about 700 hp, in sizes varying from ½ hp to 100 hp.

Motors may be seen in this plant operating almost every kind of machinery, a typical motor drive being illustrated in the accompanying photograph, Fig. 6. A few are of particular interest. In the main building is an inclined endless chain box elevator, delivering twelve boxes per minute, driven through a double-reduction belt gear by a 3-hp type C motor, bolted to the ceiling. This elevator parallels the outside walls of the building and receives boxes directly from cars, delivering them to the box storage room on the fourth floor. A sawdust elevator is similarly driven by a 1-hp motor through double-reduction gear. In the oil and japan department may be seen a row of electrically-driven pumps for transferring oil and turpentine directly from storage cars to tanks in yards and storage buildings. These replaced an equipment of steam pumps, which were found under test to require over 100 pounds of steam per hp per hour. In the varnish storage building, where it is necessary to maintain a constant temperature, a motor-driven fan is installed in a pit in the central court, surrounded by tier upon tier of iron galleries containing tanks of varnish undergoing the ageing process. In the printing department a 30-hp type C motor supported upon a suspended wooden frame, as shown in Fig. 6, drives a small line of printing presses, each supplied with cone pulleys for obtaining the variations in speed. Separate motor drives were considered in this connection, but the simplicity of the present arrangement was found to outweigh the advantages and extra cost of the variable-speed, independent motor drive.

By far the most important power applications in this factory are

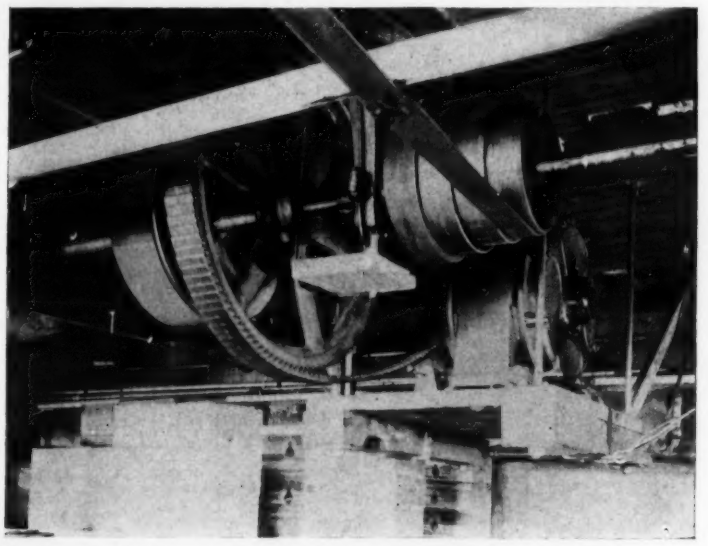


FIG. 6.—INDUCTION MOTOR BELTED BY CHAIN TO LINE SHAFTING.

the paint-grinding mills and mixers. The former are all of the rotary disc type, with vertical spindle, driven from beneath through 90° mitre gearing. The mills vary in size from 16 in. to 30 in. These machines, which have been developed by the experts of the Sherwin-Williams Company, are installed in long rows, containing in some cases as many as twenty mills of uniform size. In the experimental grinding department, where samples of material are tested, a 30-hp motor hung from the ceiling beneath drives a dozen or more mills and mixers. A line of 21-in. mills is driven here by a 100-hp motor running at a speed of 580 r.p.m. and geared to the main driving shaft by Morse silent chain. Similar lines of 30-in. mills and mixers are driven by 75-hp and 100-hp motors, respectively. In the cases of the heavier drives, Morse chain gearing has replaced belting or spur gear with excellent results.

A somewhat novel application of power is that of a motor generating set for operating some twenty or more graphophones used in the correspondence department. A ½-hp induction motor direct-connected to a 15-volt, direct-current generator is suspended from the floor beneath the department in question, each graphophone taking its current from a main extending under the floor.

Three electric elevators are in use in the main building, one for freight with a capacity of 4,000 pounds, at 60 ft. per minute, and two passenger elevators. Westinghouse type F motors are employed in each case, with controlling appliances.

In handling this large assortment of motors, it is obvious that if some system were not adopted to prevent simultaneous starting, the power plant would be seriously handicapped and the regulation of the system temporarily demoralized from this source. A single motor attendant is, therefore, employed, one of whose duties is the regular starting of all motors in the plant above 30 hp. As it is impossible for him to start two or more machines simultaneously, the load upon the power plant gradually increases from zero to its daily maximum without serious fluctuations in voltage. All large motors are, of course, equipped with double-voltage starting boxes, while those below 5 hp are connected directly to the system.

In the old engine-driven plant Westinghouse two-phase compensated field generators were used in order to secure good voltage regulation. Under the present conditions, however, the regulation secured from the turbo-generators is sufficient to render unnecessary any special devices of this character. It is found that with the motor-starting schedule serious fluctuations in voltage are almost entirely avoided, with the exception of that due to two elevators, at which time the drop is usually within 3 per cent. or 4 per cent.

The operation and maintenance of the entire power system of the Cleveland works has been brought to its present state of perfection through the efforts of J. C. Beardslee, general superintendent, and Mr. F. W. Ballard, mechanical and electrical engineer, who is directly in charge.

Storage Battery Exhibit at St. Louis.

In Section 20 of the Palace of Electricity, at the Louisiana Purchase Exposition, is located the exhibit of the Electric Storage Battery Company, of Philadelphia. As this is the largest, most comprehensive and instructive exhibit ever made of storage batteries and apparatus used in connection with battery installations, a visit to this display will be of great interest to electrical engineers.

One of the prominent features is a large map of the United States, about 30 by 45 ft., on which is indicated, by means of colored jewels, the railway feeder panels and panels for regulating railway power house loads. Two motor-driven boosters are also shown, the smaller being used in connection with the model battery, and the larger a standard 100-kw railway regulating booster.

Among the types of Chloride accumulators are three H-61 cells, with a discharge capacity of 4,800 amp. for one hour, six cells type G-77, capacity 3,000 amp. for one hour, and type G-17 and F-17, all of these being in standard lead-lined wooden tanks. The smaller cells shown are types "F," "E" and "D," in glass jars, and types "E" and "D" in rubber jars for train lighting and yacht lighting. There is also shown a very complete set of Exide cells for automobiles, and Exide sparking sets for gas and gasoline engine ignition. The Exide exhibit includes a large easel, showing in detail the various component parts of that battery.

At one end of the space is a group of three large end cell switches, operating from the Edison three-wire panel. Each of these switches is of 2,000 amp. capacity and is motor-driven, with electrical indicators. These end cell switches are in actual operation and are so arranged that each switch may be driven by its own motor, or by means of clutches any two or all may be driven by any one motor. Clutches and hand wheels are also provided whereby the motors may be thrown out of gear and the switches operated by hand.

The model battery, with its booster and switchboard, forms a very interesting working exhibit. The battery is of type E-15, in lead-lined wooden tanks, and is mounted on white enamel brick tiers. The battery is in every particular an exact model in miniature of the larger railway installations. The battery is insulated from the brick tiers by means of standard double insulation, consisting of vitrified bricks, then glass insulators, then prepared wood stringers and another set of glass insulators.

On the switchboard controlling the model battery are the necessary battery and booster switches and automatic circuit-breakers, with their interlocking devices, a Bristol recording voltmeter and the Weston instruments, consisting of voltmeter, the 0-center battery ammeter, the generator ammeter and the total load ammeter. The

EXHIBIT OF ELECTRIC STORAGE BATTERY COMPANY AT ST. LOUIS EXPOSITION.

the location and character of the various installations of the "Chloride accumulator." The exhibit includes a model battery house, in which is installed a model regulating railway battery operating on a variable load. Five standard marble switchboard panels are shown, including the panels for controlling the model railway battery. The other panels are an Edison central station three-wire panel, the panels for regulating combined lighting and power loads, conditions under which the model battery operates are exactly similar to street railway conditions. The generator delivers the average current required and as a heavy external load is thrown on the system the battery assumes the load, the needle of the generator ammeter remaining almost stationary. As the load is thrown off the battery automatically charges. The external load is caused by starting up the 100-kw booster and by throwing on a bank of 80

100-cp lamps. As an example of how well the battery regulates the load, it may be stated that the direct-current circuit supplying power to the exhibit is limited to 100 amp. With the battery regulating, a load of 300 amp. is thrown on the system, causing a drop in the lighting or generator circuit of less than 1 volt in 110, and a rise in current in the line, or generator circuit, of less than 7½ per cent. of the total load. The action of the battery is automatically controlled by the small booster and its carbon regulator. Referring again to the type G-77 Chloride accumulator it may be stated that 584 cells of this type have recently been installed on the system of the St. Louis Transit Company. This is the largest individual installation of storage batteries in the world.

The Holophane Exhibit at St. Louis.

The exhibit of the Holophane Glass Company at St. Louis is extensive and beautifully arranged. The main building consists of an excellently proportioned booth, designed after a Greek temple. Surrounding this are plate glass show cases filled with Holophane scientific glassware. Very handsome fixtures are used both on the outside and inside of the Holophane booth; and these are entirely supplied by Cassidy & Son, the well-known fixture manufacturers. The interior of the main building is divided into three large rooms, the center of which is finished as a handsome dining-room, with ceilings and wall of paneled oak and a beautifully carved oak mantelpiece, made by Sypher & Co., of New York.

The illustration that we give of the center room of the Holophane booth is from a photograph taken on the spot by the artificial lights themselves, and demonstrates the difference in illumination that can be obtained by the use of Holophane glass. Exactly the same quantity and power electric lamps were used on both sides on similar fixtures. The only difference was that on one side of the room Holophane glass globes were used, and on the other side ground and opaline glass globes, such as are now in current use. A large shade which pulled down in the center of the room cut off one section from the other and the dining-table set with white cloths gave an opportunity for contrast in the lower half of the two rooms. As near as could be judged, the illumination on the Holophane side of the room was certainly at least double that of the other side; that is to say, as far as all the lower portion of the room was concerned.

The new Astor hotel, at the corner of Broadway and Forty-fifth Street, one of the largest and most beautiful hotels in New York, and which has just been opened, took out over 2,000 ordinary glass globes and reflectors—those of the ground glass sort, which are generally "thrown in" with fixture contracts, regardless of how much light is wasted by their use—and replaced these with Holophane globes and reflectors. It is quite certain that no hotel management would discard thousands of globes already in place just before the opening of the hotel and replace these with other glassware unless there was some remarkable benefits to be obtained by doing so. It was only after careful experimenting done by the new management of the Astor hotel that it was decided to discard all the glass supplied with the fixture contract and replace with Holophane glassware. The reason why this was done is shown in the following table, which is from tests made by the New York Electrical Testing Laboratories on the ground glass shades taken out as compared with the Holophane reflectors (or Pagodas) which replaced them.

Angles.	Lamp alone.	Lamp with ground glass reflector.	Lamp with Holophane reflector.
0°	6.9	12.1	58.
15°	7.5	12.8	45.4
30°	9.6	14.3	26.5
45°	12.0	15.8	20.6
60°	14.2	14.0	16.6

A careful study of the candle-power given at all the useful downward angles by the Holophane reflector, as compared with the ground glass shade, cannot leave much doubt in any practical person's mind that Holophane glassware must pay for itself in a very few months by the increased illumination given at no extra cost for the electricity.

HOLOPHANE EXHIBIT, ST. LOUIS EXPOSITION.

Several months ago, after careful tests covering a period of nearly a year, the General Electric Company decided to adopt the Holophane reflector (known under the trade-mark of "Pagoda") for use with its new Meridian lamps, which are meeting with such a favorable reception, owing to their illuminating efficiency and excellent light distribution and general beautiful appearance. The General Electric Company has also decided to adopt the Holophane globe as a standard for its new Orthochrome lamp, which is soon to be put on the market. Besides the General Electric Company, the following companies intend to use exclusively, as far as prism glass goes, Holophane scientific glassware: Bryan-Marsh Company, the Columbia Incandescent Lamp Company, Western Electric Company, the Buckeye Electric Company, the Fostoria Incandescent Lamp Company, the Shelby Electric Company, the Sunbeam Incandescent Lamp Company, Limited, of Canada; Independent Incandescent Lamp Co., the Warren Electric & Specialty Co., the Colonial Electric Co., New York & Ohio Co., and the Brilliant Electric Co.

Electric Savings Banks.

An exceedingly ingenious line of savings banks for the spare-change depositors is being placed upon the market by the Louis Manufacturing Company, 51 Broadway, New York. In mechanical construction the banks are compact, of convenient pocket size and attractively finished. The coin which is to be deposited is placed in a slot immediately above a revolvable disc, which has been given a form imitative of the combination operating knob of standard safes (Fig. 1). A partial revolution of the knob draws the coin to the interior of the bank, from which it can by no possible means be extracted through the entering slot. This is a distinguishing feature of the banks, and it insures that only when the proper operating key is employed can the coins be removed. Each bank is provided with a hinged bottom, held in place by a spring catch, which is immune from the attack of any blacksmith's key and from any external or internal influence of a mechanical nature. Joined to the catch is a mass of soft iron arranged to be attracted by a magnet when placed in the proper position.

In the bank shown in Fig. 2 the core is so designed that when the bank is closed its two prongs are flush with the surface of the rear of the bank, and since the opening of the bank requires that the

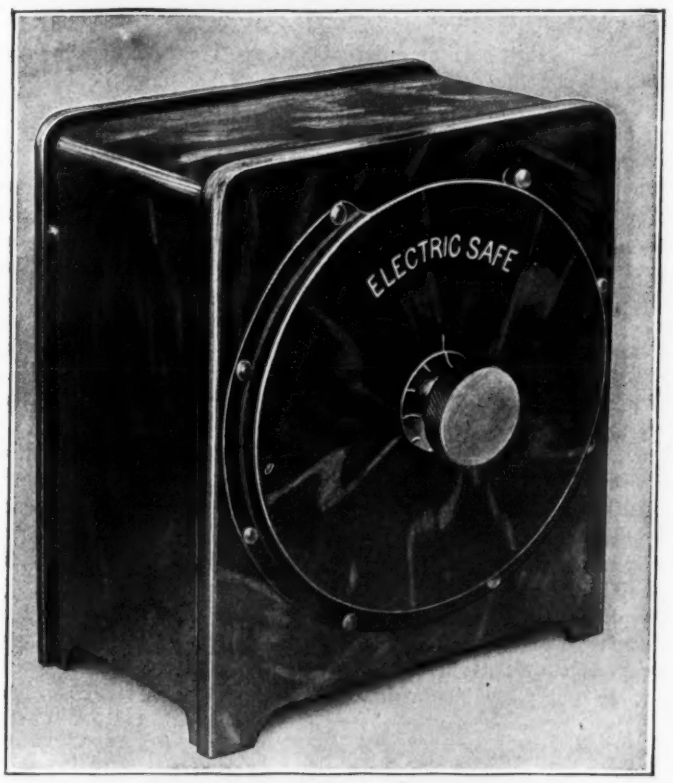


FIG. 1.—ELECTRIC BANK.

prongs be drawn outward no device other than a magnet is capable of releasing the catch. A relatively powerful magnet is necessary for overcoming the force of the spring, so that the catch is not responsive to magnets other than those of proper strength. Being purposely covered with several turns of wire conspicuously arranged, the magnet has received the appropriate name "electric key."

A type of bank which is especially applicable for use by trust companies and similar savings institutions is shown in Fig. 3. In external appearance this bank is quite similar to the one just described, while the coin-depositing knob and catch have been retained unaltered. A difference is found in the bottom releasing mechanism, of which no part is exposed to the external surface, and which requires a very powerful electromagnet for its operation. The electromagnet, which is contained in the compact case shown in Fig. 2, is designed to be energized by current from an incandescent lamp circuit, an attachment plug and cord being supplied as the "electric key." In the circuit to the coil of the magnet is placed within the case a contact key, which remains open except when the coin-receiving drawer is in place. The removal of the contents is accomplished by placing the bank in the "electric key," as seen in Fig. 3. The drawer being then pushed to place, the electromagnet is energized, releasing the catch and allowing the bottom to open and the coins to be deposited in the drawer. On removing the drawer the electric circuit is opened, the bottom may be closed and the bank again placed in active service.

A third type of bank is built on lines quite similar to the above, but it is arranged to be opened by the heating effect of current, from

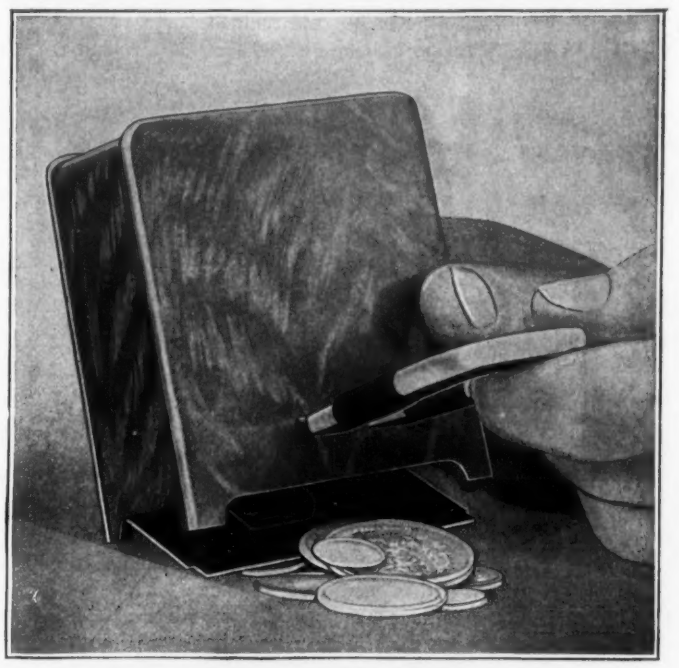


FIG. 2.—OPERATION OF "ELECTRIC KEY."

a cell or several small cells, upon a fusible wire, which serves as a mechanical means of holding closed a catch which a conveniently located spring tends to throw open at all times. The fuses are designed so as to be easily replaced, and additional ones may be kept

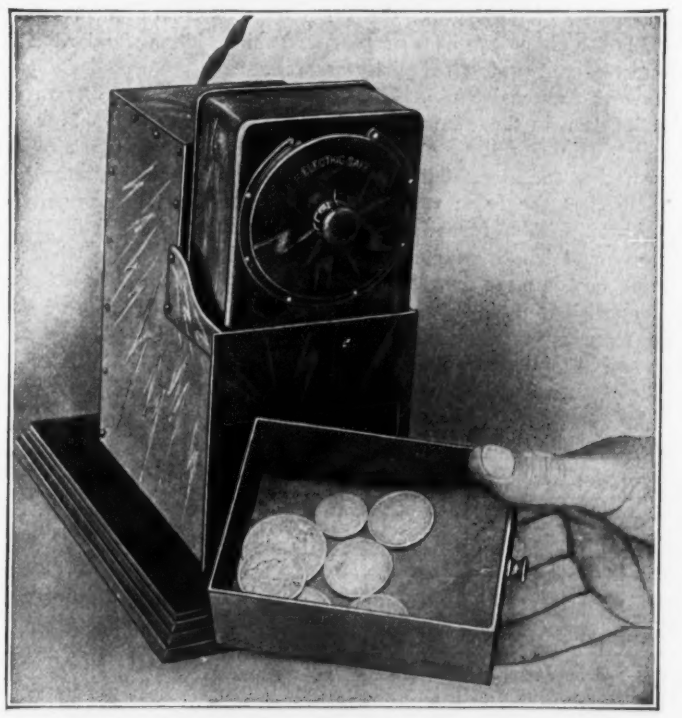


FIG. 3.—ELECTRO-MAGNETIC RECEIVING DEVICE IN OPERATION.

on hand for relocking the bank after its contents have been removed. The electrical circuits are properly insulated and all mechanical and electrical operating devices are protected from injury. This type of bank is intended for use by individuals, its "electric key" being miniature dry batteries or other convenient cells.

The extra locking fuses supplied with the bank are ready formed to the proper length and size, and are equipped with small paper handles to facilitate insertion into the spring catches. The amount of energy required to melt the fuses is comparatively insignificant, so that the diminutive cells will prove adequate for all service to which the bank will be put.

Relation of Electric Heating Devices to Central Stations.

From a paper read by H. W. Hillman before the Ohio State Electrical Association, at its meeting held at Sandusky, Ohio, August 16 to 18, the following statements have been taken as being of special interest to central station managers and their customers:

Fig. 1 illustrates a form of the General Electric "Suspended Unit"

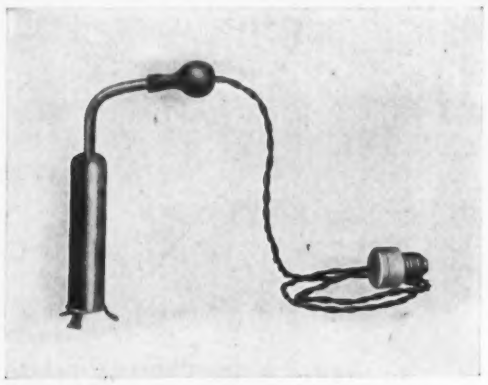


FIG. 1.—SUSPENDED UNIT.

heater, which transforms an ordinary utensil into an individually-heated one. So extensive is this line of devices that the dishes purchased from the 5 and 10-cent store will be as available for use with electric heating units as the nickel and silver-plated cooking utensils have been in the past. Every household with electric lighting circuits will demand these convenient devices. They will be so commonly known and will become so indispensable as a household utensil that additional residence customers will quickly follow. When the people once appreciate the benefits derived from such devices they will demand them as common household utensils.

In describing the edgewise winding used as a heating unit, particular attention is called to its simple construction. With this design the dishes are so made as to afford perfect ease in disassembling for repair. The units are the same dimensions, the dishes being suitable for either 250-watt or 500-watt units. Thus standardization is effected, and utmost simplicity assured. This is an essential point in favor of extensive use. The unit illustrated lends itself readily to a location in the utensil, that is valuable in respect to high efficiency. The durability of the unit will be appreciated when it is known that for more than a year the edgewise winding units have been used at the Lynn works of the General Electric Company, in connection with a furnace for drying out transformer coils. The severity and length of such service has led to the belief that this heating unit is more durable than any previous design. This feature has appealed to us so strongly that advantage has been taken of using high temperature heat, thus securing maximum work in quickest time and at minimum expense.

The electric flatiron offers a splendid illustration of a convenience that cannot be secured with gas. Fig. 7 is an illustration of the three-pound size. To do the average family ironing, at a 10-cent rate, it costs the residence customer the nominal sum of 22 cents, yet the annual income to the station is more than $5,000 for 500 irons only. Each iron will earn about $11 annually, or nearly one-third of the income from the average residence customer for lighting. This refers to simply one electric heating device. These devices may appear insignificant to you, but when introduced in all residences and taken collectively they present an extensive current supply business. It is not a waste of time to dwell on such matters. You cannot possibly induce a residence customer to turn on an incandescent light during the numerous pleasant summer days, while hot water and other such conveniences are both demanded even on such days. The baby must eat regardless of season. On a Sunday morning you cannot induce customers to operate motors; nor at 11 o'clock at night. On the other hand, the chafing dish is demanded for entertaining purposes and heating devices are convenient even on Sunday.

From the foregoing it follows naturally that every employe should commence to study this subject; should become acquainted with electric heating devices. The subject differs from industrial motors with respect to personal trial. It is more like incandescent lighting. The trial should not end with lighting circuit devices, but should extend to cooking, baking and ironing devices. An assortment of utensils comprising such an outfit is shown in Fig. 8. There is much to learn and investigate in connection with handling the business on an extensive scale, and station managers cannot appreciate this point too early.

FIG. 3.—EGG BOILER, INTERIOR.

In an average family of five, with a servant of ordinary intelligence, with a 5-cent rate, and with no attempt at economy, it will cost an average of $6 per month to cook, bake, iron, turn on the air heater occasionally and use the chafing dish now and then for evening entertainment. It is my opinion that cooking, baking and ironing can be accomplished for an average of $4 per month at a 5-cent rate for a family of four or five persons, after devices have been operated longer and are better understood. Gas stoves have been introduced so extensively and the electric cooking and baking outfits are so little known even by central station people, that it will require strenuous effort to build up a large business.

The arguments in favor of the business are many and attractive. The average residence income can be easily doubled and frequently trebled. During the summer season it is exactly the business which a "station physician" would prescribe. It is also a "day-load" business, which residence trade has never known in all the past history of the electrical industry.

When the motor business confronted you several years ago, there were many obstacles to be overcome. It did not become a successful business in a day. When the gas companies commenced to realize the value of the heating load to their business there were obstacles to be overcome, but they have been boldly and effectually surmounted, with the result that a magnificent business was established. In the next six months your investigation will prove that electric heating devices possess remarkable merit. Then the same aggressive methods adopted by the gas companies and by your motor department will produce wonderful results. The devices are attractive to the people, and no other branch of your business will be more interesting, or easier to promote successfully.

Rates of charge will become an easy problem to solve. To-day the motor rate may not be exactly the same as the lighting rate. In the sale of current circumstances require variation in rates of charge.

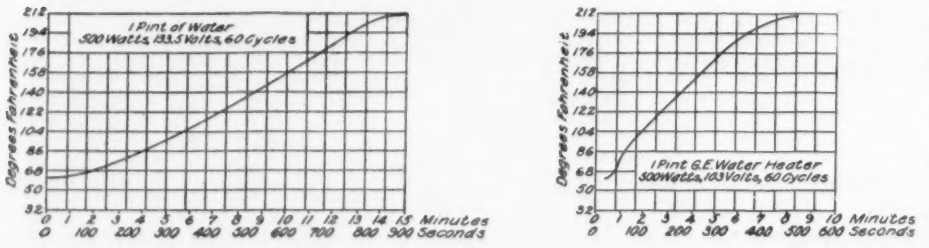


FIG. 2.—DIAGRAM SHOWING COMPARATIVE EFFICIENCIES OF THE DISK STOVE AND THE CENTRUNIT UTENSIL IN BOILING A PINT OF WATER.

FIG. 4.—COFFEE POT.

It is common for gas companies to make a lower rate for heating than for lighting. It frequently happens that the rate for current in one city varies from that in an adjoining town. The central station has met with an easy problem in establishing a motor rate, and it will be no more difficult to establish a heating rate. Surely, enough has been said and written in connection with rates of charge, so that every central station manager is fully informed on the subject.

The instantaneous electric water heater will be of great assistance

FIG. 5.—COFFEE PERCOLATOR ON "MISSION" STYLE HEATING TABLE.

FIG. 7.—THREE-POUND FLAT IRON.

FIG. 8.—KITCHEN HEATING TABLE.

to central stations. It is proposed to make it small in size; to be screwed to any threaded water faucet; to be installed in connection with any washbowl without materially disturbing existing plumbing; to be placed on any shower bath and furnish water of any temperature without a special water mixer for cold and hot water. For new houses a "one-faucet, one-pipe electric system" will be the cheapest, most convenient and latest hot and cold water system yet known. One heater in the kitchen, one in the laundry, one over the bathtub and one over the washbowl, would complete the residence equipment. Instead of heating 30 gallons of water in a tank, together with a hundred feet of piping, to secure a little hot water for breakfast dishes or for bathroom use, the instantaneous electric heater will furnish a half gallon of water per minute at 100° temperature. It will flow a faster stream at lower temperature, or a slower stream at higher temperature. The intermittent service harmonizes with household practice, and maintains operating expense at a minimum. For an average house the hot water piping and tank alone requires an investment of $150 to $250, depending upon the class of material used. The instantaneous electric water heater will not only be more

FIG. 6.—BABY MILK WARMER, TAKEN APART.

convenient and have higher efficiency, but will effect an economy in first cost of installation.

Electric air heaters of all kinds, sizes and styles are available. Three styles are shown in Fig. 9. Service shows that they are practical devices for auxiliary heating in the spring and fall seasons. In the north, east, south and west there is certainly a large demand for air heaters, and the new era in connection with heating devices should popularize and extend the use of electric air heaters. Operating costs and the initial cost of heaters should be made known, so that individuals building houses can intelligently consider them.

It is well to cover the special wiring needed quite fully, as it is frequently mentioned in discussing heating devices. The central station manager will find his company in the same position as the gas companies when gas stoves and heaters were presented to the public. A campaign is necessary on the subject of wiring. Let us encourage the contractor to advertise his own business. Let him issue monthly flyers illustrating how easily special wiring can be done. Every gas customer secured might have been a customer for the contractor and the central station. Where is the contractor's catalogue? Why not show plans of wiring—a good-sized print—red lines for lighting wires, blue lines for heating circuit? Why not make photographs of certain attractive features of house wiring which represent excellence of design and skillful work? Why not make a profession of contracting engineering? Why not show the circuit and outlet for the flatiron? This whole subject means a campaign of education among the people and the electrical contractors. It will not be long before the wiring of residences will afford double the income to the contractor. Every house will be wired with a circuit to the kitchen for the cooking and baking outfit, just as a chimney has been always furnished with the house for a stove. Every owner will vie with other real estate men to have the latest and most improved accommodations for electric heating devices. Almost all houses nowadays are wired for lighting. The time has come for central stations and for electrical contractors to advertise and promulgate the best and latest methods of house wiring. Let us all strive to have every new house wired for heating *as well as* lighting devices.

Fig. 3 illustrates the location of the heating unit in an egg boiler and shows the origin of the term "Centrunit Heater." The liquid immediately surrounds the unit and the heat must necessarily dissipate itself through the liquid. Lightning "impartivity" of the heat to the liquid is thus secured. Even imagination cannot conceive of a more perfect design with respect to high efficiency. The pair of diagrams, Fig. 2, shows the rapidity and economy with which water can be heated with the centrunit heater compared with the disc stove and an ordinary cooking utensil. Suffice it to say that the use of the

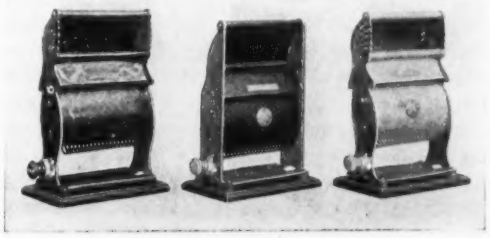


FIG. 9.—ELECTRIC AIR HEATERS.

disc stove should be confined to toasting bread, and should forever disappear as a utensil for heating water.

The egg boiler, shown in Fig. 3, accommodates six eggs, and with a 500-watt winding will cook three-minute eggs in ten minutes' time. At ten cents per kilowatt-hour the cost of boiling six eggs, with the centrunit egg boiler, is 8 mills, or approximately one mill per egg.

The coffee pot, Fig. 4; the coffee percolator, Fig. 5; baby milk warmer, Fig. 6; water heaters, and all other such devices, are of the centrunit type, insuring minimum cost of operation. To heat a pint of water for shaving costs but two-tenths of one mill. To boil coffee for breakfast, for a family of the average size, costs but eight-tenths of one cent.

The operating cost is so low that it is a foregone conclusion that, respecting this feature also, the devices will meet with great favor among the people. The initial cost to the people for the new heating

devices is well within the reach of all. The central station has now arrived at a period when initial cost and operating cost of electric heating devices will be no more considered by the people than a 5-cent fare on an electric railway car. In making this statement I have in mind those cities and towns where I know the central station will purchase the devices and sell them to the people at cost, because they are current-consuming devices.

When a department store secures an article or a new line which it is believed will appeal to the people, the utmost vigilance is exercised in its introduction and to promote sales. The same relation exists between the central station and the people in respect to electric lighting devices and the extension of industrial motors. It is common knowledge that central stations do advertise and aggressively promote the use of devices which consume current, but I desire to emphasize the point that *now* the time has arrived when electric heating devices should be advertised, introduced and extended by the central stations, among their residence customers. One of the first mediums for advertising the words "Electric Heating" is offered in connection with tables. Fig. 8 illustrates a table for the kitchen. The furniture and department stores are ever anxious to introduce a fad. Electric tables are novel and offer excellent opportunity for attractive advertising. A window display of electric heating tables, with a few devices in operation from the common lighting circuit, would draw customers who would purchase other commodities.

The baby milk warmer offers a convenience in the bedroom which is not possible with any other method of heating. The coal range never provided such a convenience. A gas range located in the kitchen is useless in the bedroom. Where bedrooms are piped for gas, it is necessary to have the gas burning continuously or else to light a match whenever heat is wanted.

Condensers in the St. Louis Fair Plant.

The condensers of the main power plant at the St. Louis Fair, two in number, and of the elevated jet type, were furnished by Henry R. Worthington. They are located in Block 38, Machinery Hall, in the space between the columns supporting the building and the overhead cranes, in order to clear the latter. At the junction of the horizontal and vertical lines of exhaust piping is located a cast-iron entrainer, which forms a water pocket, draining the horizontal pipe and so directing the exhaust steam that it will pick up any water collected in the pipe and carry it along to the condenser in the form of spray. At the top of each exhaust riser is an automatic relief valve, which, in case of loss of vacuum, provides a safety vent to the atmosphere through a line of vertical spiral riveted pipe extending through the roof. A characteristic of this type of condenser is the use of separate water and dry vacuum pumps. The former in the present case are three Worthington turbine pumps in the Steam, Fuel and Gas Building, driven by Westinghouse single-acting engines.

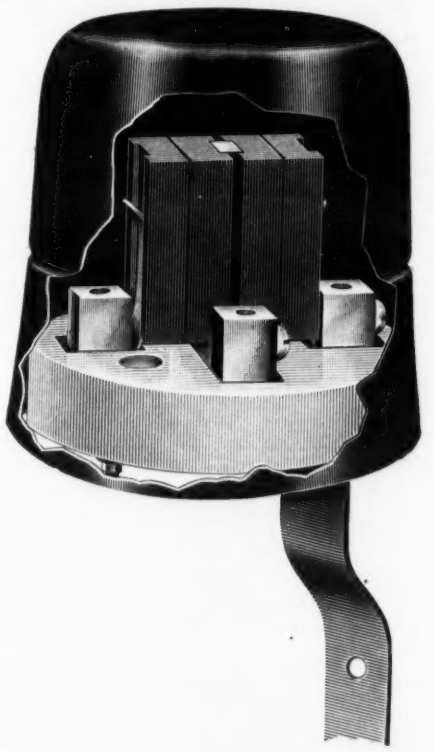
The condenser is elevated about 30 ft. above the hot well, and the water descends by gravity against the atmospheric pressure. The vacuum pumps are used to exhaust the air from the condenser and the steam pipe system. Before the air passes to this pump, however, it is cooled by an air cooler in the injection pipe, which decreases its volume and practically frees it from water. The dry vacuum pumps differ from other vacuum pumps in that, as the name indicates, no water is used in the air cylinders, the pistons being lubricated by oil the same as the steam cylinders and the clearance spaces being reduced to a minimum, as in air compressors. To still further increase the efficiency of this apparatus a small auxiliary valve is used, which, after the exhaust valves have closed, opens a passage from one to the other side of the piston and permits the gases in the clearance space to expand into the suction side of the cylinder. Before the piston starts on the return stroke this valve closes and, there being no gas or air under pressure in the cylinder or ports, it draws at once from the condenser. This method greatly increases both the capacity and efficiency of the pump. The absence of water and the positive control of the suction valve permit a high rotative speed.

Two of the vacuum pumps in this plant are of the horizontal type. The positive inlet and discharge valves are adjustable by a hand wheel, while the steam is controlled by a slide valve with an adjustable eccentric to vary the point of cut-off according to the steam pressure. The suction air valve is positively driven by an eccentric on the shaft, which is so set as to open the ports fully at the proper time, leaving an unobstructed passage for the attenuated air and vapor to enter the cylinder. The steam and air pistons are on a common piston rod.

In addition to the horizontal vacuum pumps there is a vertical pump, with an enclosed crank case, the air and steam pistons being on independent rods. The other features of the vertical machine, however, do not differ materially from the horizontal machine just described. All three pumps draw from a common vacuum header, which in turn is connected to the cones of the two condensers. The vacuum pumps are supplied with steam from the engine auxiliary piping system, and the exhaust is turned into the main condensing system. The air discharge is led through spiral piping to the roof. The condensers and dry vacuum pumps are located in Machinery Hall, a short distance from the Westinghouse engines.

A New Type of Lightning Arrester.

The American Electric Fuse Company, of Chicago, is placing upon the market the new design of lightning arrester intended for telephone service, which forms the subject of the accompanying illustration. It is constructed of carbon blocks between which has been left an air space .01 of an inch wide. The dielectric is so arranged that the carbon dust, caused by lightning discharges, does not form a conducting path between the terminals, but falls out easily at the bottom of the carbons. On the block which forms the bottom of the arrester are placed three binding posts, two for the line and one for the ground connection. The wires pass up through the posts, which are hollow, and are secured thereto by means of screws. The block is mounted on a porcelain base and is substantially connected therewith. A galvanized-iron brace serves for attaching the arrester to a line pole or to the side of a house, while a galvanized iron hood protects the entire block from the weather. The arresters should be placed along a toll line at intervals of one-half mile or at the points of transposition, and when so used trouble from electrostatic disturbances is reduced to a minimum.



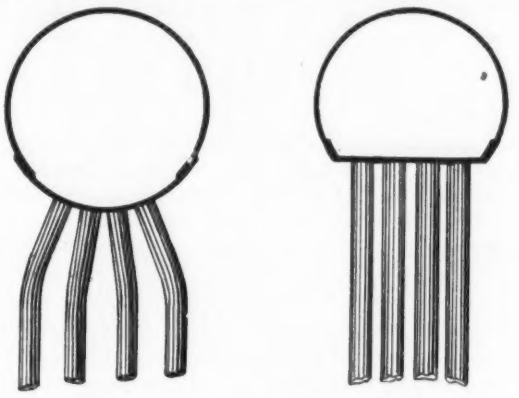
LIGHTNING ARRESTER.

Lighting Equipment for Garden City.

The Garden City (L. I.) Company has placed an order for light-equipment consisting of two 70-kw General Electric alternating-current, 2,220-volt generators arranged for direct connection to 110-hp Harrisburg-Fleming side-crank engines.

Water Tube Boiler.

In the construction of the Rust water tube boiler there have been introduced many novel features which render its thermodynamic efficiency especially high and eliminate many objectionable mechanical details found in the ordinary type of boiler design. The tubes are placed in a vertical position so that all sediment collects in the



FIGS. 1 AND 2.—VERTICAL TUBES.

mud drum, from which it may be taken when desired. When horizontal tubes are used, not only does the internal surface of the tubes become coated from the material held in suspension in the water, but flue dust accumulates on the upper surface, thereby further decreasing the thermal conductivity of the tube. Straight tubes have been substituted for the familiar curved ones, in order that the scale may be removed with the least expenditure of labor and with

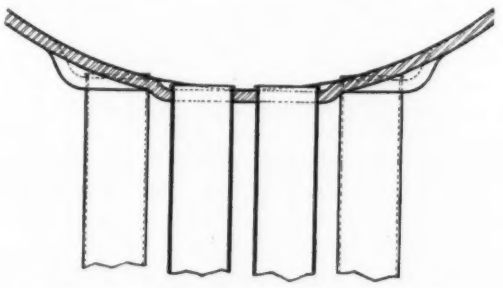


FIG. 3.—SECTIONAL DIAGRAM OF TUBE SHEET.

a degree of certainty of results not obtainable with curved tubes. The patent tube sheet, used in the construction of the drums, is the most novel and characteristic feature of the Rust boiler, allowing, as it does, the use of cylindrical drums without flat surfaces or bent tubes. Experience has shown that it is necessary for the tubes to connect to the drum normal to the surface if a thoroughly reliable joint is to be made. Recognition of this fact led to the use of curved tubes with cylindrical drums, as shown in Fig. 1. In order to obviate the necessity of employing bent tubes, the plan was adopted by some makers of flattening one side of the drums, as illustrated

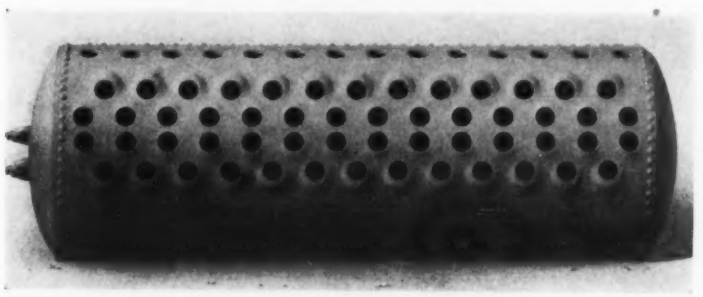


FIG. 4.—44-INCH DRUM WITH PRESSED TUBE SHEET.

in Fig. 2. The flat surface is, however, subjected to bending strains, and builders were compelled to introduce stays to support the flat sheet, which constructive feature is especially objectionable in a water tube boiler. The unique scheme used in the Rust boiler is shown in Figs. 3 and 4. The tube sheet is formed by heating the flat plate to the proper temperature, then pressing the sheet hydraulically between dies especially constructed for the purpose. An important feature of this construction is that there remain undisturbed cylindrical belts of the original surface of the drum. As will be seen from Fig. 5, the boiler proper consists of two steam and water drums, two mud drums and an auxiliary drum. The tubes are placed staggered, thereby securing a more complete exposure to the hot gases, while the spacing is such as to leave room enough between the tubes of the outside rows to enable the removal of the tubes of the inner rows, thus allowing any tube to be removed without disturbing any other tube. The arrangement of the furnace and

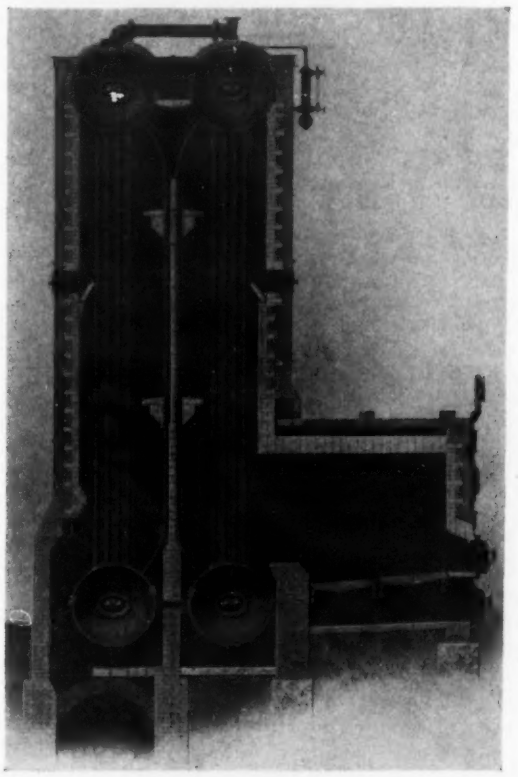


FIG. 5.—BOILER ARRANGED FOR UNDERGROUND FLUE CONNECTION.

the passageway for the gases, as seen in Fig. 5, insures good water circulation and most effective distribution of hot gases over heating surface, so that all portions are perfectly effective, while the equipment as a whole occupies small floor space and does not require excessive head room. The Rust Boiler Company, of Pittsburg, is the manufacturer.

"New England Motor" Storage Batteries.

The New England Motor Company, of Lowell, Mass., is placing upon the market a line of storage batteries for stationary and vehicle work, which while not exhibiting anything startlingly novel in construction, show features of merit. The cells are of the pasted type. The oxides are applied to moulded grids in the usual manner. The negative plates, after being formed, are subjected to considerable pressure, so as to consolidate the spongy lead and make it more adhesive. The positive grids are oxidized before being pasted. In the vehicle type cells, grooved wooden separators are used. The wood is treated by a special process to prevent the formation of acetic acid or gum-dextrin. The details of this process are not given, but it has been the result of considerable experimentation. The New England Motor Company has been building these batteries for some two and a half years, and using them on automobiles and launches, with a view of testing their efficiency thoroughly and their capability of withstanding hard usage. The result has more than come up to its anticipations.

While no special effort has been made to obtain large output per pound in the vehicle type cells, still the performance is very creditable. The 150 amp. hour cell at a 4-hour rate weighs complete 28 lbs., and this is claimed to be lighter than any other cell of equal capacity on the market, being an output of 10 watts, at a 4 hour rate, per pound complete cell. At the same time, the grids are of such a form as to give great mechanical rigidity, so that, as above stated, mechanical efficiency has not been sacrified for weight. Special machinery has been designed for the production of the plates.

New Type Annunciators.

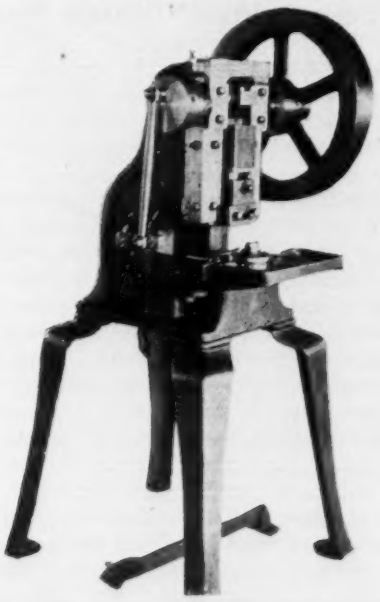
The accompanying illustration shows one of the "Quality" annunciators recently placed upon the market by Plummer, Ham & Richardson, of Worcester, Mass. The face of the annunciator is composed to black enameled iron strips arranged in shutter fashion, with an opening between strips through which the white celluloid target appears when released. The target appearing against the solid black background attracts attention at a glance, a very desirable feature in hotel annunciators. Another advantage claimed is that the targets

ANNUNCIATOR.

cannot be accidentally jarred or shaken down, which feature should appeal strongly to those using annunciators in elevator, railroad and marine work. This result is obtained by attaching a small phosphor-bronze spring to the armature with a bearing on the coil, and holding it away except when the coil is energized. This spring, while heavy enough to do the work required of it, is so slight that two dry cells will operate the drop. This annunciator is very compact, its small size especially recommending it for places where space is an item, and is made in all the standard styles.

Press With Dial Feed.

A form of press specially intended and largely used for electrical work, jewelry, novelties, etc., is here illustrated. The dial feed is of simple construction and is operated by a pawl. It has a locking device, so that the plate is always in perfect position before



PRESS.

the operation takes place. Different plates can be easily attached, owing to the adjustment, whereby different spacings may be easily obtained. The press is, in fact, a regular type of the machines made by the Perkins Machine Company, of Warren, Mass., but is rigged up specially for the dial feed.

Power and Mining Machinery Company's Gas-Electric Plants.

The increasing importance of gas engines as prime movers in electric service is shown by a list of gas-driven electric generators which have been installed by the Power & Mining Machinery Company. We note a few items. At the works of the Winchester Repeating Arms Company, New Haven, Conn., the gas apparatus consists of eight 9 x 15-ft. Loomis generators, boilers, scrubbers, etc., together with two holders of 10,000 cu. ft. capacity. The engine plant contains five 3-cylinder, 16 x 18 vertical Westinghouse engines direct connected to 100-kw direct-current Westinghouse engine type generators, the current being used for both power and light. The gas generated is distributed throughout the works for operating numerous gas engines and for furnace work. The plant of the Rockland Electric Company, Hillburn, N. Y., contains Westinghouse engines and generators as follows: Three-cylinder, tandem, double acting 4-cycle, 19 x 24 in., 300-hp engines, two of which are direct connected to 225-kw, two-phase revolving field alternators, 60 and 440 volts, and the other is belted to two 110-kw, 250-volt, direct current generators; one 3-cylinder vertical 15 x 14 engine direct connected to a 225-kw two-phase revolving field alternator and one 2-cylinder vertical 10 x 11 direct connected to a 125-volt exciter generator. The gas, which is obtained from four 9 x 15 ft. Loomis generators, is also used throughout the shops of the Ramapo Iron Works for heating purposes. Six 9 x 15 Loomis generators form the gas plant of the Valardena Mining & Smelting Company at Valardena, Durango, Mexico. In addition to four 2-cylinder, 600-hp horizontal Crossley engines, belted to 250-kw alternating-current generators, the gas is supplied to a 1-cylinder, 18½ x 27 in. engine, which operates a direct-current exciter for the alternators. This is believed to be the largest installation in the world using manufactured gas in engines. For general power and lighting purposes there have been installed at San Luis, Potosi, Mexico, for the Potosina Electric Company, two Westinghouse vertical, 2-cylinder engines and three Westinghouse horizontal double-acting tandem engines direct connected to 100-kw, alternating-current generators, the gas being obtained from four 8 x 14 Loomis generators of the most improved type. At the Sayles' Bleacheries, Saylesville, R. I., the two 9 x 15 Loomis generators supply gas for operating a Westinghouse 3-cylinder, 19 x 22 vertical engine, which is direct connected to a 150-kw generator, producing direct current for lighting and power purposes. The gas is used principally, however, for singeing purposes. Provision has been made for the installation of a 2-cylinder, 22 x 30 in. American Crossley engine for direct connection to a 150-kw Westinghouse direct-current generator.

Ceiling Switch.

The ceiling switch illustrated herewith, which is manufactured by P. Sorensen, 45 York Street, Brooklyn, N. Y., will find a wide application on account of the ease of its operation. As will be seen, the switch rod is extended through the back of the switch case and a

CEILING SWITCH.

ratchet and pawl placed upon the end. To the pawl lever is attached a cord which hangs down within easy reach for the operation of the switch from the floor. One pull on the cord closes the switch and the next pull opens it.

This switch has received the approval of the Fire Underwriters.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was bullish in tone and tendency, the adverse crop reports having no apparent effect thereon. Speculation quieted down, however, toward the end of the week, on the approach of the holidays. The granger and Pacific stocks, the anthracite shares and the Southwesterns were all irregularly strong, while notable activity prevailed in the Steel group, accompanied by advances. The controversy between the management and motormen had a depressing effect on Manhattan Elevated, also on Interborough Rapid Transit, the latter breaking sharply on what looked like liquidating sales. Metropolitan Street Railway fell to 118⅛, but recovered some of the loss and closed at 121½, this being a net loss of 1¼ points. Brooklyn Rapid Transit was not affected by the situation in the big borough across the river and made a net gain of 1½ points, closing at 55⅜. There were some marked gains in the industrial electric group, Allis-Chalmers being the single exception, it being unchanged. General Electric gained 5 points, closing at 169, and Westinghouse 2, the closing price being 161. Western Union showed some activity and closed at 90¾, which is ¾ point better than the last quotation. American Telephone & Telegraph closed at 137⅝—1⅜ points less than the closing price of the week previous. Outside securities on the curb were generally higher and more active, Interborough Rapid Transit being an exception, owing to causes already noted. Following are the closing quotations of the Stock Exchange September 6:

NEW YORK

	Aug. 30	Sept. 6		Aug. 30	Sept. 6
Allis-Chalmers Co.	11	11	Electric Vehicle	13⅛	12
Allis-Chalmers Co. pfd.	47	50⅛	Electric Vehicle pfd.	18	17
American Tel. & Cable.	89	89	General Electric.	165	169½
American Tel. & Tel.	137⅛	137	Hudson River Tel.	...	...
American Dist. Tel.	22	22	Interborough Rap. Tran.	146	146
Brooklyn Rapid Transit.	54⅜	55⅜	Metropolitan St. Ry.	119¾	120⅜
Commercial Cable.	180	185	N. Y. & N. J Tel.	153½	..
Electric Boat.	39	39	Marconi Tel.	...	...
Electric Boat pfd.	70	70	Western Union Tel.	89¾	91
Electric Lead Reduction.	⅜	⅜	Westinghouse com	160	161⅛
			Westinghouse pfd	180	190

BOSTON

	Aug. 30	Sept. 6		Aug. 30	Sept. 6
American Tel. & Tel.	...	137½	Western Tel. & Tel. pfd.	89¾	90
Cumberland Telephone.	117¼	117¾	Mexican Telephone.	1¼	1⅛
Edison Elec. Illum.	240*	259	New England Telephone.	125	126
General Electric	165	169	Mass. Elec. Ry.	14	12¼
Western Tel. & Tel.	13¼	13⅛	Mass. Elec Ry. pfd.	63⅛	60¾

PHILADELPHIA.

	Aug. 30	Sept. 6		Aug. 30	Sept. 6
American Railways.	48¼	48⅜	Phila. Traction.	90	89½
Elec. Storage Battery.	60	64½	Phila. Electric.	6¾	6⅝
Elec. Storage Battery pfd.	60	84⅛	Phila. Rapid Trans.	14⅜	14⅜
Elec. Co. of America	9¼	9¼			

CHICAGO

	Aug. 30	Sept. 6		Aug. 30	Sept. 6
Central Union Tel.	..	..	National Carbon pfd.	112	115*
Chicago Edison.	145	150	Metropolitan Elev. com.	21	21
Chicago City Ry.	180	183	Union Traction.	7¼	7
Chicago Tel. Co.	120	..	Union Traction pfd.	33	31
National Carbon.	38	40			

* Asked

NEW YORK CITY RAILWAY.—The first annual report of the New York City Railway Company (the new name of the lessee of the Metropolitan Street Railway system), for the year closed on June 30 shows that the gross earnings of the system from operation, amounting to $21,485,006, indicate a decrease of $64,539 as compared with last year. President H. H. Vreeland says that this is largely due to the severity of the winter. The repeated heavy snowfalls, which the Street Cleaning Department was unable to remove for weeks, forced the street vehicle traffic onto the company's tracks, thus greatly impeding the movement of cars and discouraging traffic. Operating expenses amounted to $12,127,855, an increase of $738,746, which President Vreeland charges also to the length and severity of the winter. A large increase is also shown in the expenditures of the accident and claim department, due to the activity of the courts in settling suits and the great number of cases settled before trial. After all deductions from income are made, the statement shows a deficit of $1,396,770. No new mileage has been added to the system except in The Bronx and in Westchester County. Reference is made in the report to the ten-year contract for running cars over the Williamsburg Bridge, and it is said that the service will begin as soon as the tracks are ready. President Vreeland says that the season's programme of electric construction has been considerably curtailed by unsettled labor conditions. One hundred new closed cars for use in this borough have been received and 100 more have been ordered. The report calls attention to the success of the new power system north of the Harlem River.

The total number of passengers carried has been 630,070,850, an increase of nearly eight millions over last year. Of these, 72,194,495 were carried in The Bronx; 197,595,680 were transfer passengers. The company owns 492 miles of tracks, of which 99 are used for horse cars. It still uses 4,036 horses in its operation.

BIG TELEPHONE BOND ISSUE.—A Chicago financial paper announces the filing for record of a trust deed for $50,000,000 made by the State Independent Telephone & Telegraph Company, of New Jersey, to the American Trust and Savings Bank as trustee. The loan obtained is in the nature of a bond issue which has been obtained for the following purposes: To acquire, improve, extend, enlarge and develop the property the telephone company has purchased from the Northwestern Telephone Company of Illinois and the personal property of said company, upon which property there is an existing bonded indebtedness of $500,000, and the telephone company as a part of the purchase price of property so acquired is desirous of redeeming and retiring its bonded indebtedness. The bonds are payable January 2, 1927, and draw 5 per cent. interest The trust deed is on all property of the State Independent Telephone & Telegraph Company and the company has offices in Jersey City, Chicago and Aurora.

CALIFORNIA GAS & ELECTRIC.—The following is a comparative statement of earnings of the California Gas & Electric Corporation, San Francisco, for the months of July, 1903 and 1904:

	1904.	1903.	Increase.
Gross earnings	$320,857.45	$213,473.47	$107,383.98
Operation, maintenance, taxes, insurance and bond int. of sub. co's.	242,713.64	159,619.28	83,094.36
Profit	$78,143.81	$53,854.19	$24,289.62
Corporation bond interest	36,458.34	33,333.33	3,125.01
Balance	$41,685.47	$20,520.86	$21,164.61
Sinking fund	12,500.00	12,500.00	.....
Net surplus	$29,185.47	$8,020.86	$21,164.61

BROOKLYN LIGHTING GROWTH.—The stockholders of the Kings County Electric Light & Power Company, as of record on September 6, are offered the right to subscribe at par until September 16 for $1,250,000 new stock, pro rata. Payment for stock subscribed for must be made as follows: Fifty per cent. on or before October 1, 1904, and the balance on or before January 3, 1905, or, if preferred, payment may be made in full on or before October 1, 1904. The company is one of the most prosperous and progressively managed in the country.

ELECTRIC VEHICLE SUIT.—Richard Siegman, of New York, has renewed his suit against the Electric Vehicle Company, charging that Martin Maloney and other directors of the company were parties to the alleged illegal, fraudulent issuing of dividends upon the preferred and common stock of the company in the years 1899 and 1900 in the aggregate amount of $704,800.

DIVIDENDS.—The Metropolitan Street Railway Company has declared a quarterly dividend of 1¾ per cent., payable October 15.

Commercial Intelligence.

THE WEEK IN TRADE.—A very favorable week is reported in fall trade at the leading centres, and the business done was the largest since the opening of the season. Crop reports have in the main been favorable, improvement being noted in corn and cotton. Wheat reports from the Northwest are not altogether satisfactory. Rain has retarded harvesting, and the feeling that the crop damage in that section has not been exaggerated received some support. The maximum possible yield is now placed at 550,000,000 bushels. The situation in the industries is still unsettled, and the general tone of labor affairs is irritating. The threatened strike of elevated railway employes and the disorganized condition of the building trades by reason of the strained relations between employer and employe are the predominant features in the labor situation in New York. Collections are reported indifferent—in fact, backward. Business failures in August were more numerous than in July in nearly all sections, and the liabilities were in excess of those involved in the failures of the same month a year ago. The number for the week ending September 1, as reported by *Bradstreet's*, was 189, against 185 the week previous and 162 the corresponding week last year. The situation in iron and steel shows no change, and copper is quiet, although there was an effort to advance prices.

Closing quotations of copper are 12⅝ to 12¾c. for Lake; 12½ to 12¾c. for electrolytic and 12⅜ to 12½c. for casting stock. Railway earnings are still maintained, the returns showing slight gains over last year.

CONTRACTS PENDING FOR MEXICAN MINES.—A big lot of American electrical equipment will shortly be purchased for shipment to Mexico, where it will be installed in the extensive mining property which is to be developed on a large scale by the Braniff Mining & Smelting Company, just organized, in the southern republic with a capital of $3,000,000 gold. Oscar Braniff and Thomas Braniff, Jr., of Mexico City, are primarily interested in the enterprise. The Braniff firm is one of the most important handlers of United States machinery, etc., in Mexico. It takes care of the Westinghouse interests in that part of the world. The United Mining & Development Company, Knickerbocker Trust Company Building, is also largely concerned; John F. Wallace, head of the Panama Canal work; William McFarland, vice-president of the Westinghouse Electric & Manufacturing Company; Josiah Quincy, former Mayor of Boston; Rear-Admiral Melville; M. S. Browning, the small arms manufacturer of Ogden, Utah, and Charles A. Disbrow, of Harrisburg, Pa., are among the well-known men interested in the United Company. John Thomson is president of the company and E. Gybbon Spilsbury, of the Spilsbury Engineering Company, 42 Broadway, is chief consulting expert. Both these gentlemen have just returned from Mexico, where they recently went in connection with the deal. The properties are known as the Cadereyta mines and are located in the State of Queretaro. Some $500,000 will be expended in development work. Power to carry on the mining operations will be derived from a waterfall on the properties. The old steam plant will be discarded. The smelters are expected to be increased four-fold. A large concentrating plant is also to be erected at Macoui. Its initial capacity will be 200 tons a day, but ultimately it will reach 500 tons. Considerable cableway work will also be carried out. The famous El Doctor mine is located in the properties acquired. The district is expected by experts to become one of the great mining camps of Mexico in the near future, which will result in the installation of quantities of electrical machinery.

MANUFACTURING EXPORTS.—Manufactures formed nearly one-half of the exports from the United States in the month of July. Speaking with statistical accuracy, they formed 48.27 per cent. of the total domestic exports. For the first time in the history of the United States manufactures are exceeding agricultural products in the exportation of domestic products. Figures just issued by the Department of Commerce and Labor, through its Bureau of Statistics, show that in the month of July manufactures exported amounted to $40,000,000, against $31,000,000 of agricultural products; and in the month of June manufactures amounted to nearly $42,000,000, against $37,250,000 of agricultural products. The fact that the exports of manufactures from the United States in the fiscal year just ended were the largest in the history of our commerce, and that during the last three months they have actually exceeded the value of agricultural products exported, lends interest to some figures just compiled by the Department of Commerce and Labor through its Bureau of Statistics, showing the growth in the exports of principal manufactured articles from 1870 to 1904, and the increase in importations of materials for use in manufacturing during the same period. The statement divides the manufactures into ten great groups, which form, it says, about 80 per cent. of the total value of the manufactures exported. These ten groups are iron and steel, mineral oils, copper, agricultural implements, wood manufactures; chemicals, drugs and dyes, leather and manufactures thereof; cotton manufactures, paraffin, and paper and manufactures thereof. Iron and steel show the largest total, being in round terms $112,000,000; mineral oils, $72,000,000; copper, $57,000,000; leather, $34,000,000; agricultural implements, $23,000,000; chemicals, $13,000,000; wood manufactures, nearly $13,000,000; paraffin, over $8,000,000, and paper, over $7,000,000.

WESTINGHOUSE ENGINE ORDERS.—The Westinghouse Machine Company has some interesting foreign orders on hand for steam engines to be shipped to different parts of the world. Engines are now under construction for Colon, Central America; Iquique, Chili; the Panama Railway Company and Lagua Le Grand, Cuba. Several orders have also been taken lately for gas engines. The list includes machines for the Greensburg (Md.) Gas & Electric Company; John S. Hibbs, of Hammondsburg, N. Y.; Portland Cement Company, of Iola, Kansas; Union Forge Company, of Pittsburg, Pa.; Union Switch & Signal Company, of Swissvale, Pa.; the Department of Agriculture, Washington, D. C.; Warwood Tool Company, of Glenora, W. Va.; Wheeling (W. Va.) Mould & Foundry Company; the Wilmerding (Pa.) Electric Light Company and H. C. Codden Company, of Columbus, O.

40,000-HP OF MORRIS TURBINE FOR CANADIAN-NIAGARA PLANT.—The long anticipated award of the initial contract for the water turbines to be installed in the huge power plant under construction at the Canadian side of Niagara Falls by the Toronto & Niagara Power Company has at last been determined on. The turbines will in the first instance be four in number and of 10,000-hp capacity each. The contract has been undertaken by the I. P. Morris Company, of Philadelphia. These turbines will be direct-connected to 7,500-kw generators to be built by the Canadian General Electric Company. Mr. F. S. Pearson, of 29 Broadway, is the consulting engineer for the Toronto company. Mr. W. P. Plummer, same address, is purchasing agent.

OTIS ESCALATOR CONTRACT.—In further reference to the contract secured by the Otis Elevator Company for escalators to be installed in the new Boston store leased to Henry Siegel, which was noted in last week's issue, Charles D. Seeberger, of the Otis Company, who is the inventor of the escalator, said to a representative of this journal, that the ten machines would all be electrically operated and would have an aggregate capacity of not less than 40,000 passengers per hour. The motors will be 10 hp each. The value of the contract is about $100,000. The largest escalator system so far installed in this country is at the Macy store, where four machines are in operation.

GENERAL ELECTRIC EQUIPMENT FOR LAWRENCE CORDAGE WORKS.—The Lawrence Cordage Works have acquired the plant of the New Jersey Zinc Corporation at Jersey City and have awarded a contract to the General Electric Company for the complete electrical equipment, which will represent an expenditure of considerably over $100,000. The equipment will include two 400-kw. generators—alternating current—and 33 motors varying in capacity from 10-hp. to 80-hp. It is interesting to note that the accepted figures were lower for alternating current equipment than were bid on for direct current machinery.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, of Chicago, has recently installed a complete telephone plant connecting the various towns in central Wisconsin and offices along the lines of the Green Bay-Kaukauna Interburban Railway system and the Fox River Valley Electric Railway & Power Company, recently built by the Knox Construction Company, of Chicago. The telephone plant consists of an "International" self-restoring drop switchboard, located at the main offices of the Electric Company, with long-distance bridging telephones at every branch of the business.

GENERAL ELECTRIC EQUIPMENT FOR JAPANESE COTTON MILLS.—The power plant of the Mizi Cotton Mills, Japan, one of the largest of its description in the Far East, is to be considerably enlarged. General Electric equipment will be installed. The contract is being handled through Mitsui & Company, the great Japanese mercantile house, which acts as representative of the General Electric Company's interests in the Mikado's kingdom.

POWER FOR CHIHUAHUA MINES.—Mexican advices state that a power plant will be constructed at the Eldorado station on the Parral branch of the Mexican Central Railway, State of Chihuahua, from which the electric current will be carried to the Central mining property at Almoyala. The property has lately been purchased by N. O. Bagge, of Los Angeles, Cal., who proposes to utilize electricity on a somewhat extensive scale.

POWER FOR EL ORO MINES.—The Esperanza Mining Company, which operates one of the largest properties in the El Oro district, Mexico, is to abandon the use of steam power for electricity. The current will be transmitted from the Necaxa plant of the Mexican Light & Power Company. Mr. J. T. Hill, electrical engineer, Mexico City, is to be in charge of the Esperanza installation work.

MORE POWER FOR EL ORO.—The El Oro Mining & Railway Company has decided to employ electricity on an extensive scale for the operation of its El Oro properties, which will mean the purchase of a large quantity of motors, etc. Power will be derived from the Mexican Light & Power Company's Necaxa plant, situated some 140 miles distant.

EQUIPMENT FOR JERSEY CITY TRACTION.—Mackenzie, Quarrier & Ferguson, of 114 Liberty Street, New York, have taken an order for a Harrisburg-Fleming tandem compound engine of 300-hp capacity for direct connection to a Crocker-Wheeler generator to be installed in the power plant of the Jersey City Traction Company.

CURTIS TURBINE FOR JAPANESE LIGHTING PLANT.—The Nagoya (Japan) Electric Light Company's plant is to be extended and American equipment will be installed. A contract has just been placed through the Japanese house of Mitsui & Company for a 500-kw Curtis turbine set.

CHICAGO'S NEW POWER HOUSE.—Bids will be opened on September 17 by the electrical department, Chicago, for condensers sufficient for the operation of two 1,200-hp Buckeye engines. Bids on pumps will probably be readvertised.

General News.

THE TELEPHONE.

WASHINGTON, D. C.—A certificate of incorporation of the Home Telephone Company, capital stock $300,000, has been recorded here. The incorporators are George H. Corey, Eugene Schooley and J. L. Cohencious.

ALTON, ILL.—The ordinance committee of the Alton City Council has discovered that the Central Union Telephone Company has no franchise to do business in this city. The 25-year franchise of this company expired during the first part of this year and no new franchise has been applied for. The matter will be reported at the September meeting of the Council.

CHICAGO, ILL.—Receivership proceedings against the United Telegraph, Telephone & Electric Company, with a possible foreclosure of the property of the company, have been begun in the Superior Court by the Chicago Title & Trust Company, on the assertion that the interest on $174,400 worth of outstanding bonds is overdue. The company was organized Jan. 2, 1899, with a capitalization of $500,000.

CARLYLE, ILL.—The telephone lines of Clinton County have been consolidated and are now operated under one management. Geo. Johnspeter, who owned the line from Posey, Hoffman and Keysport to Carlyle, has purchased the interests of the Southern Union Telephone Company, in this county, which includes the exchanges at Carlyle, Breese, Trenton and Germantown. The consideration was $5000. The lines will be extended to all towns, villages and points in the county.

URBANA, IND.—The Urbana Independent Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $10,000. Emanuel Stover heads the board of directors.

PRINCETON, IND.—The directors of the Independent Telephone Company and the Farmers' Telephone Company met at Francisco recently and took steps toward consolidating the two systems at that place.

BICKNELL, IND.—The Bicknell Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $10,000. R. H. Pickel, John T. Phillippe, Harmon Buck and E. T. Cox are the incorporators.

GENEVA, IND.—The Geneva Telephone Company has increased its capital stock $2000, for the purpose of making extensions and installing a new switchboard and other modern equipment. A. G. Griggs is president and H. M. Aspy, secretary.

LOGANSPORT, IND.—The Bell Telephone people are seeking a franchise to do business in this city. The ordinance has been prepared and will be presented to the council at its next meeting. The public is averse to another local system and is generally opposing the new franchise measure.

INDIANAPOLIS, IND.—Cupid is disorganizing the ranks of the telephone operators in the local exchanges, and the managers are becoming alarmed over the situation. During the month of May, 26 girls out of 190 got married, and nearly as many more resigned in June for the same reason.

INDIANAPOLIS, IND.—The new directories recently issued by the Indianapolis Telephone Company and the Central Union Telephone Company affords the following comparative statement: Number of new long-distance offices in Indiana, 1322; number of Central Union offices in Indiana, 411; number of offices reached by the new long-distance and not by the Central Union, 1036; number of offices reached by the Central Union and not by the new long-distance, 1255; number of offices common to both, 286.

ARDMORE, I. T.—The Missouri & Kansas Telephone Company is building an extensive system of long-distance telephone lines in Indian Territory and Oklahoma. It will run from Oklahoma City, Okla., to Denison, Tex., crossing the Chickasaw Nation. J. W. McAlester is manager, with present headquarters at Sulphur, I. T.

GALENA, KAN.—The Galena Telephone Company recently incorporated here has a capital stock of $100,000, instead of $10,000, as previously reported. Mr. M. L. Robeson is manager of the company. The company operates exchanges at Galena, Wier City, Columbus and Scammon.

WASHINGTON, KAN.—The Washington Mutual Telephone Company has been organized here with the following officers: John King, president and O. G. Lobaugh, secretary. This is an organization of farmers for their own benefit. They will incorporate and proceed at once to build their line.

FRANKFORT, KY.—The Hillsboro & Flemingburg Telephone Company has filed incorporation articles with the Secretary of State, capital $260.

BANGOR, ME.—The North Penobscot Telephone Company, of Bangor, has been incorporated, capital $5000. Promoters: W. H. Thompson, P. E. Averill, Jesse Osgood, S. A. Lothrop, Prentiss; R. S. King, Daniel Lindsey, Carroll; H. P. Osgood, S. L. Leach and S. C. Jensen.

BLAINE, ME.—The Aroostook Farmers' Telephone & Telegraph Company has organized at Blaine, for the purpose of constructing and operating telegraph and telephone systems in Aroostook County. Capital $100,000, of which nothing is paid in. The officers are: President, F. A. Hackett, of Blaine; treasurer, H. D. Hussey, of Blaine.

FALL RIVER, MASS.—The Fall River and New Bedford Automatic Telephone companies are to be consolidated and the system extended in Taunton and Brockton. The capital of the Fall River Company is $135,000 and the capital of the New Bedford Company is $100,000.

CORRELL, MINN.—The Artichoke & Correll Telephone Company has been incorporated with $10,000 capital stock.

GLASGOW, MONT.—R. J. Moore has been granted a telephone franchise in this place.

CANASTOTA, N. Y.—The Canastota Telephone Company is to be granted a franchise with a capital stock of $15,000. Chas. J. Wood, of Utica, is promoter of the new company.

MARILLO, N. Y.—The Marillo Telephone Company, of Marillo, has been incorporated, capital $3000. Incorporators: Howard Adams, J. G. Bartoo and Wm. Bates, all of Marillo.

STAMFORD, N. Y.—The Delaware & Schoharie Telephone Company, of Stamford, has been incorporated, capital $2000. Incorporators: H. P. Hubbell, E. W. Landon and M. S. Wood, all of Stamford.

ALBANY, N. Y.—The Kitchawan Telephone Company, of Kitchawan, Westchester County, has been incorporated, capital $1000. Directors: D. L. Chadeayne, E. C. G. von Pim and H. B. Forman, of Kitchawan.

ALBANY, N. Y.—The Union Telephone Company, of Point Peninsula, Jefferson County, N. Y., has been incorporated, capital $1000. Directors: F. M. Wiggins, A. R. Washburn and M. R. Holbrook, of Point Peninsula.

SYRACUSE, N. Y.—A certificate of extension of the Wayne-Monroe Telephone Company has been filed at Lyons. The lines as extended will cover Wayne County and Monroe County as far west as Rochester. A line will be run through Ontario County and Cayuga County to Auburn, connecting all intermediate points as far south as Geneva. From Auburn a line will run through Weedsport and Onondaga County to Syracuse. Another line will extend from Wolcott through Fair Haven to Oswego covering all intervening villages.

DAYTON, OHIO.—The Home Telephone Company, of Dayton, has voted to increase its preferred stock from $400,000 to $600,000, the new stock to retire $200,000 of the $450,000 outstanding bonds.

JENNINGS, OKLA.—M. T. Sherman, of Joplin, Mo., will install a new telephone system at Jennings.

FREDERICK, OKLA.—The Frederick Telephone Company has been organized for the purpose of installing a telephone system.

FOSS, OKLA.—The Northwestern Telephone exchange has been organized at Foss with a capital stock of $5000. S. H. James is one of the incorporators.

SHARON, PA.—W. H. Wilson, of Erie, general manager of the Union Telephone Company, states that negotiations are on for the acquisition of the Mercer and Lawrence Counties Telephone Companies, which will perfect the system connecting Erie, Pittsburg, Buffalo and Cleveland. More than 1200 miles of copper wire will be strung.

BUTLER, PA.—For the purpose of permitting large extensions of its lines the People's Telephone Company, of this city, has been changed from a limited partnership to an incorporated concern, with $50,000 capital stock. The following are the officers: President, John Younkins; secretary, Marion Henshaw; treasurer, Thomas F. Shufflin; John V. Ritts and Albert H. Reiber.

GRANBURY, TEX.—The Granbury telephone exchange and long-distance lines have been purchased by Walter Juliff and Earl Cogdell. The new owners will extend the line from Bluff Dale to Stephenville.

VICTORIA, TEX.—The Board of County Commissioners of Victoria County has granted a franchise to citizens of the town of Victoria and of Mission Valley for the construction of a telephone line between this place and Mission Valley.

EL PASO, TEX.—The receiver has been discharged in the bankruptcy case of Mrs. Anna M. Brett, who has for several years been promoting an independent telephone system in El Paso, and it is announced that the system will now be completed as fast as possible.

NACOGDOCHES, TEX.—The Nacogdoches and Southeastern Telegraph & Telephone Company has been organized here. An application for a charter has been forwarded to Austin and upon its being received here work will be started by a construction company putting up poles and wires.

EL PASO, TEX.—The City Council has under consideration an application made by R. A. Wooldridge and C. F. Wren for a telephone franchise. Messrs. Wooldridge and Wren agree to put in a complete system at a cost of not less than $100,000 and to post a forfeit of $5000 with the city that the terms of the franchise will be complied with in every respect.

RICHMOND, VA.—The Frederick & Shenandoah Telephone Company has been incorporated with a capital stock of $500 to $1000. The officers are Isaiah Funkhouser, president; I. A. Graves, vice-president; E. R. McDonald, secretary, and H. A. Richards, treasurer.

ROCHESTER, WIS.—The Burlington, Rochester & Kansasville Telephone Company will increase its capital stock from $5000 to $10,000. Geo. W. Rountree is president.

HICKORY GROVE, WIS.—The Hickory Grove Farmers' Mutual Telephone Company has been incorporated, capital stock $360. The incorporators are Charles Kalish, Olaf Haffland, Joseph Riley, Christian Colbad and John Lindeliur.

KINGSTON, ONT.—The financial committee of the city council of Kingston, Ont., has set aside a proposal to grant a five-years' telephone franchise to the Bell Telephone Company. The company, it is stated, has refused the offer, and the Independent Telephone Company is in the field with a proposal.

WINDSOR, ONT.—A representative of the Independent Telephone Manufacturing Company, of Chicago, has been in Windsor looking for a Canadian site for a factory. The factory will be run in connection with the Ontario Independent Telephone Company, which is bidding for franchises in Canadian cities and towns. The Bell Company has an exclusive franchise in Windsor which has yet two years to run, but the Independent company will contest the right for an exclusive franchise.

MONTREAL, QUE.—There are now 14,700 telephones in use in the city of Montreal, as shown by the new telephone book of the Bell Telephone Company. The increase of subscribers over last year was 900, and the increase the year previous was 600, thus indicating that the demand is steadily growing. With the big gain that Montreal has made, that city has now about 4000 more telephones in operation than Toronto.

442

ELECTRIC LIGHT AND POWER.

HARRISBURG, ARK.—The business men have secured a subscription of $4000 for the purpose of establishing water works and an electric light plant.

THORNTON, ARK.—The Pine Bluff City Electric Company and the Stout-Greer Lumber Company, of Thornton, have secured the contract for the installation of an electric light plant at Thornton.

VACAVILLE, CAL.—It is proposed to establish a water and light plant here at an estimated cost of $35,000. Address Chief Engineer Steiger.

MARYSVILLE, CAL.—Jason R. Meek has filed a notice of water appropriation for 30,000 inches of Dry Creek to be used for generation of power for electrical purposes and for irrigation.

SAN FRANCISCO, CAL.—At the regular annual meeting of the Central Light & Power Company, J. W. Pauson, manager, the old board of directors and officers were re-elected. This company expended a considerable amount in alterations and improvements during the past fiscal year. The electric generating plant is still located in the basement of the Parrot Building.

SAN FRANCISCO, CAL.—At the recent annual meeting of the Marysville & Nevada Power & Water Company, the following officers were elected: W. W. Waggoner, Nevada City, president; L. H. Mitchell, Marysville, vice-president; J. K. O'Brien, Smartsville, treasurer; J. E. Ebert, Marysville, secretary. Members of the corporation are quoted as saying that they will have an electric power plant in operation before the close of next year. A telephone line has been constructed by the company from its dam on the Yuba to Clipper Mills.

SAN FRANCISCO, CAL.—Specifications have been prepared by Cory, Meredith & Allen, engineers, for the initial installation of the Washoe Power & Development Company, of Reno, Nev. President J. E. Humphrey and Secretary Norcross are residents of Reno. A 1500-kw, 3-phase generator will be direct connected to a water wheel operated by water from the Truckee River under an effective head of 85 feet. The hydraulic work is in progress, the 2½ miles of ditch having been completed. A flume 3300 feet in length, resting on the ground, is in course of construction. Power will at first be transmitted to Reno, a distance of 8 miles, and to Sparks, 3 miles distant, where the new Southern Pacific Railroad shops are electrically operated.

GAINESVILLE, GA.—The town of Gainesville will have a new lighting system as soon as the transformer and lights are installed. Current will be supplied by the North Georgia Electric Company. The old lighting system has become inadequate to the demands upon it.

IDAHO FALLS, IDA.—A power plant will be erected on Snake River, ten miles south of here, by the Idaho Power & Transportation Company.

MEDORA, ILL.—Mr. Frank Watson, proprietor of the electric light plant here, intends to install a larger direct-connected unit.

WHEATON, ILL.—The Dupage County Electric Light & Power Company, of Wheaton, has been incorporated with a capital of $30,000. Incorporators: E. C. Faber, D. J. Peffers and C. E. Flenner.

CHICAGO, ILL.—The Van Buren Electric Light Company, of Chicago, has been incorporated with a capital of $50,000. Incorporators: Howard D. Maise, Thos. F. Low and Harold M. Dewar.

SPRINGFIELD, ILL.—The United States Circuit Court has ordered the sale of the plant of the Chester Light, Water & Power Company, of Chester, Ill., on application of the Union Trust Company, of St. Louis.

SEELEYVILLE, IND.—N. B. Stanley has been granted a franchise to establish a plant for electric lighting in this city.

MT. VERNON, IND.—A charter has been granted to the Mt. Vernon Electric Light & Power Company with a capital of $5000. The directors are J. H. Purdy and Wm. K. Dunbar, of Pittsburg, Pa., and Robt. D. Morris and G. V. Menzies, of Mt. Vernon.

SIOUX CITY, IA.—The Sioux City Gas & Electric Company has decided to expend about $20,000 in improvements. L. L. Kellogg is manager.

HOPKINSVILLE, KY.—Articles incorporating the Hopkinsville Gas & Electric Company, with $25,000 capital stock, $15,000 preferred, have been issued to W. T. Tandy, W. C. White and James A. Young, Jr. This is a reorganization of the Hopkinsville Light & Power Company, which furnishes the city with electric light.

OPELOUSAS, LA.—The Board of Aldermen has awarded contracts as follows: To the General Electric Company for 70 arc lights, $2292; Stanley Instrument Company, Great Barrington, Mass., 250 electric light meters, $2242.

FAIRFIELD, ME.—The Winthrop & Wayne Light & Power Company has organized at Fairfield for the purpose of supplying gas and electricity for lighting, heating and mechanical purposes in the towns of Winthrop, Monmouth, Wayne and Readfield. Capital, $50,000, of which $300 is paid in. The officers are: President, C. L. Sturtevant, of Fairfield; treasurer, C. O. Sturtevant, of Fairfield.

BOSTON, MASS.—Bids will be received Sept. 17 by Mordecai T. Endicott, Chief of Bureau of Yards and Docks, Navy Department, Washington, for furnishing and installing 3 electric dock capstans with 15-hp motors at the navy yard here.

UTICA, MICH.—The citizens have voted to issue $19,000 bonds for water works and an electric light plant.

CAPAC, MICH.—The citizens have voted to issue $7000 bonds to complete the water works and electric light plant.

MANISTIQUE, MICH.—The Manistique Light Company is about to build a new plant and completely change its service.

ALPENA, MICH.—W. H. Davidson, W. B. Taber and F. L. Richardson have been appointed a committee to proceed with the construction of a lighting plant and water works.

BROWN'S VALLEY, MINN.—The Crowley Electric Company of Duluth has submitted a proposition to establish an electric light plant here.

FRAZEE, MINN.—It is reported that E. G. Holmes, of Detroit, Mich., and others, propose to develop power from the Otter Tail River, building a dam for the purpose.

GREENVILLE, MISS.—The Delta Electric Light, Power & Mfg. Company will build, in connection with its present business, an interurban electric railway from Greenville to Leland, 9 miles from here.

NEW ALBANY, MISS.—Eugene Campbell, of University, Miss., is preparing plans for a municipal light and water plant, $20,000 having recently been voted for this purpose.

FORSYTH, MONT.—J. E. Edwards has secured a franchise for water works and an electric light plant.

CENTRALIA, MO.—At a special election held here Aug. 17, a proposition to grant a ten-year electric lighting franchise to R. H. Baldridge was carried. The new plant will be erected at once. The city was opposed to municipal ownership.

ST. LOUIS, MO.—Chief Engineer J. W. Wood, of the new City Hall, has prepared a statement showing that the city has saved in one year $21,876.32, or more than half what it cost to install the plant at the City Hall. The plant, which was installed on July 1, 1903, cost $35,000. It furnishes light for the City Hall, four courts, Courthouse, old City Hall and engine house No. 6.

PENN YAN, N. Y.—It was voted to issue $35,000 bonds for an electric light plant. N. S. Dailey is Village Clerk.

ELMIRA, N. Y.—A 1500-hp gas engine is being installed in the station of the Elmira Water, Light & Railroad Company.

GOUVERNEUR, N. Y.—Pilling & Crane, of Pittsburg, Pa., have purchased the Kearny water power, 3 miles from this village, and it is said that the firm contemplates utilizing the falls for power purposes.

PLATTSBURG, N. Y.—The council has granted a franchise to the Lozier Light & Power Company for the public and private lighting of the city. The company agrees to furnish 80 2000-cp enclosed arcs, 5 years from Nov. 6, 1904, at the rate of $71 per light per year.

CHARLOTTE, N. C.—The new electric lighting system at Charlotte put in and operated by the Catawba Power Company of Fort Mill, S. C., is now in successful operation and giving entire satisfaction.

DAYTON, OHIO.—Bids will be received Sept. 23 by the Board of Trustees of the Dayton State Hospital for furnishing and erecting boilers, engines, dynamos, motors, switchboard and equalizer for said hospital. Address A. F. Shepherd, M. D., secretary.

WILBURTON, O. T.—James Degnan, of Wilburton, will construct an electric light and power plant here to cost $50,000.

SCRANTON, PA.—Bids will be received Sept. 12 by the Board of Control for installing a central heating and electrical plant in the power house on Adams Ave. and Gibson St. Address John J. Harris, M. E.; Eugene D. Fellows, secretary.

WILKESBARRE, PA.—The Ashley Electric Light Company, which succeeded in securing a franchise from the Wilkesbarre City Council some months ago, and which, it is alleged, has been unable to enter the city on account of a defect in the charter, will make another effort to secure entrance to the city, and the projectors say they will branch out on a larger scale than at first intended.

FLORENCE, S. C.—A commission for a charter has been issued to the Light & Power Company of Florence, with a capital of $50,000. The incorporators are H. C. Case and Wm. Maul Measey, both of Philadelphia, Pa.

TRACY CITY, TENN.—The Tracy City Electric Light Company, it is said, is taking bids looking to an extension of its plant so as to include the town of Monteagle, Tenn.

GRAHAM, TEX.—Preliminary steps have been taken at Graham toward the installation of an electric light plant here.

LEONARD, TEX.—The Leonard Electric Light & Ice Company has increased its capital stock from $15,000 to $20,000.

WICHITA FALLS, TEX.—It is practically assured that the Wichita Falls Water Works Company will install a new electric light plant at Wichita Falls. R. C. Malone, manager, can give information. The electric light plant of the city changed hands on Sept. 1. M. Lasker, I. H. Kempner, D. W. Kempner, R. C. Malone and Henry Sales are the new owners. The same company owns the waterworks.

AUSTIN, TEX.—A committee of citizens of Austin and a special committee of the city council are still working on the problem of rebuilding the great dam across the Colorado River at Austin and the re-establishment of the municipal water and light plant. There is a prospect of the work being done by a local company which will be organized for the purpose.

BURLINGTON, VT.—Bellman & Sanford, New York, N. Y., have secured the contract for constructing the municipal electric light plant for $26,860.

LARAMIE, WYO.—The City Council has granted to D. H. McCutcheon and J. D. Boyles, of Pittsburg, Pa., an electric light franchise and has entered into a contract for the lighting of the city for ten years. The wires are to be run underground. The terms of the franchise also permit the construction of an electric railway system.

TORONTO, ONT.—E. J. Lennox, architect for the Toronto & Niagara Power Company, will soon let contracts for the power house and sub-station at Niagara Falls, to cost $300,000.

MANILA, P. I.—The Bureau of Engineering is considering the question of utilizing Botocan Falls and the rivers Caliraya and Lomot, in the Province of Laguna, and the Angat River at Bulacan, and the transmission of electric power thus generated to Manila and vicinity. It is estimated that between 30,000 and 40,000 horse-power can be generated.

THE ELECTRIC RAILWAY.

DECATUR, ALA.—J. L. Echols and others are figuring on the construction of an electric railway from Decatur to Trinity Mountain, 7 miles.

HUNTSVILLE, ALA.—A movement is on foot to build an electric railway from Huntsville to the top of Mt. Sano. The Huntsville Railway, Light & Power Company is interested.

WATERBURY, CONN.—The Connecticut Railway & Lighting Company has under consideration a plan to build from Dickerman's Corner in Milldale to the northern terminus of the lines of the Cheshire Street Railway Company.

BRISTOL, CONN.—The stockholders of the Bristol & Plainville Tramway have voted to increase the stock from $150,000 to $250,000. The company has been making many improvements, has completed a new car house, opened a line to Terryville and made a survey for an extension to Thomaston in the Naugatuck Valley.

JACKSONVILLE, FLA.—The Atlantic & Pacific Street Railway & Security Company has been incorporated under the laws of the State of New Jersey, with a capital stock of $300,000. This company has been organized for the purpose of absorbing the North Jacksonville Street Railway Company, better known as the "Colored Man's Railroad," and for the purpose of extending the line to the suburbs of Oakland and Moncrief Springs. The promoter of this new project is R. R. Robinson, president of the North Jacksonville Street Railway; Fred D. Robb, superintendent of maintenance of way, of the same company, and D. J. Huger, the naval stores colored operator. Associated with the above gentlemen are several of Jacksonville's most progressive colored business men.

ATLANTA, GA.—The Secretary of State has granted an amendment to the charter of the Atlanta & Interurban Railroad, which proposes to build an electric railway to Marietta. The new name is the Atlanta & Northern.

AUGUSTA, GA.—At a meeting in Baltimore, Md., of the directors of the Augusta-Aiken Railway & Electric Company and allied companies, Mr. John Blair McAfee, of Philadelphia, was elected president of the companies to succeed Mr. James W. Jackson. Mr. Jackson was elected chairman of the board of directors of the allied companies. Mr. C. G. Goodrich was elected vice-president.

WASHINGTON, IND.—W. H. Schott, a representative of Chicago and Eastern capitalists, has asked the City Council for a franchise for an interurban line through Washington to connect with Loogootee, Vincennes and Petersburg. It is proposed to incorporate the company at $1,000,000.

EVANSVILLE, IND.—An important meeting of the directors of the Evansville & Eastern Electric Railroad was held in the company's offices in this city Aug. 18. The capital stock was increased to $600,000, which will enable the company properly to build and equip the road, and General Manager Sontag was instructed to make contracts for the required materials. The power plant will be erected at Newburg at a cost of $150,000.

OWENSBORO, KY.—The Owensboro City Railway Company proposes to extend its lines a distance of 12 miles.

NEW ORLEANS, LA.—An interurban electric railway is projected between Baton Rouge and New Orleans. Agents have been in the field for some time securing rights of way, which it is understood will follow the banks of the Mississippi River. The estimated cost of the road and necessary equipment is said to be $2,500,000.

CUMBERLAND, MD.—It is rumored that Pittsburg capitalists operating the Meyersdale & Salisbury Street Railway have acquired an option on the Cumberland & Westernport Electric Railway. Ex-Judge R. H. Koch, of Pottsville, is president of the latter road.

MARLBORO, MASS.—The Boston & Worcester Street Railway Company is about to improve portions of the old Marlboro Street Railway purchased by it last year. Track repairs costing $25,000 will be made.

ALMA, MICH.—Frank H. Ohl has received a franchise to construct an electric railway to connect Alma with Ithaca.

DETROIT, MICH.—The contract for the completion of the Detroit, Flint & Saginaw Electric Railway from Bridgeport to Frankenmuth has been awarded to W. L. Patterson, of Flint. Bridgeport has been decided upon as the location of the power house.

MERIDIAN, MISS.—Application has been made for a charter for an electric railway from Woodville, in Wilkerson County, to the Mississippi River at Fort Adams. The signers of the petition were C. M. Stricker, A. M. Shepherd, of Fort Adams; James Cohen, of Ashwood; W. H. Woods, L. T. Ventress, J. D. Cage, W. L. Ferguson, of Woodville.

MISSOULA, MONT.—D. E. McKinnon, secretary and general manager of the Amador Mining & Milling Company, says his company contemplates building an electric railway from the town of Amador to the mines.

HASTINGS, NEB.—The Omaha & Nebraska Central Railway Company has filed articles of incorporation. The company is incorporated for $1,500,000, and will build and operate an electric railway from Omaha to Hastings. The incorporators are Charles J. Helm, Anthony Texter, Charles Deeter, A. G. Burke and Frank J. Helen.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company has a project afoot looking toward extending its power plant, as well as its car houses, at Omaha, Neb. Plans are not definitely determined upon as yet, although it is intended to erect an entire new power station and remodel the present station in such a manner as to convert it into a repair shop. It is possible that some of the work may not be started before next spring.

EAST ORANGE, N. J.—The Eastern Railway Construction Company, East Orange, has filed papers of incorporation in the County Clerk's office. The authorized capital stock of the concern is $125,000. Scott Mills, Paul Munter and James R. Mapletoft are incorporators. The company will build and equip steam and electric railways.

CATSKILL, N. Y.—It is said that the Catskill Electric Railway Company will extend its line to Cairo at once.

SYRACUSE, N. Y.—The promoters of the Auburn & Syracuse Railway Company plan to build a branch line from Auburn to Port Byron via Throopsville. It is likely that a separate company will be organized to build the line.

BUFFALO, N. Y.—Notice of the proposed extension of the Buffalo & Depew Railway Company's line, from Depew to Rochester, and from its present terminus into the downtown district of this city, is advertised, preliminary to making application to the State Railroad Commission for permission to build the extensions. The proposed extension eastward is from Depew, through Lancaster and Alden in Erie County, Darien, Pembroke, Batavia and Leroy in Genesee County, Caledonia in Livingston County, and Wheatland and Chili in Monroe County, to Rochester, a distance of 60¼ miles. The westerly extension to reach the business part of this city will be 7.8 miles long.

TYRON, N. C.—An electric line is projected from Tyron to Millsprings, N. C., in the mountains. T. T. Ballenger, of Tyron, is interested.

DELAWARE, OHIO.—The Delaware & Magnetic Springs Railway Company is securing right of way for an extension from Magnetic Springs north to Richwood.

DAYTON, OHIO.—The Westinghouse Electric & Manufacturing Company is preparing estimates on the cost of equipping the Dayton, Germantown & Middletown Traction Company's proposed line from Dayton to Middletown.

SANDUSKY, OHIO.—J. C. Parker, promoter of the proposed Sandusky, Clyde & Tiffin Railway, states that Eastern capitalists have agreed to finance the project. Parties in Tiffin have agreed to donate a site for a power station and car house.

LEAVITTSBURG, OHIO.—There is a report that the old steam line between Ravenna and Leavittsburg by way of Newton Falls has been sold and that it will be equipped with electricity. It is stated that the Pennsylvania & Mahoning Valley Railway is interested in the project. Such a line would give through connection from Cleveland to Warren, Youngstown and New Castle, Pa.

SPRINGFIELD, OHIO.—The foreclosure sale of the Springfield & Xenia Traction Company will take place in this city Sept. 17. In all probability the property will be bought in by representatives of the bondholders, who are working on arrangements for a reorganized company to take over and operate the property. The road has been appraised at $375,000, and at least two-thirds of this amount must be paid for it.

MANOR, PA.—Borough Council has granted a franchise to the Pittsburg & Westmoreland Street Railway Company, which will connect with the Irwin-McKeesport system.

WILKESBARRE, PA.—At a meeting of the directors of the Lackawanna & Wyoming Valley Electric Railroad it was said that it was intended to extend the road from this city to Sunbury, a distance of 64 miles.

STROUDSBURG, PA.—A trolley line to traverse the Pocono Mountain region has been projected with these officers: John B. Williams, president; Dr. A. L. Simons, secretary; George L. Waltz, vice-president, and John D. Houck, treasurer.

GREENSBURG, PA.—The Pittsburg, McKeesport & Greensburg Electric Railway Company has finally decided to build the connecting link between Irwin and Trafford City, thereby completing the connection between Fairchance and Pittsburg by trolley. The distance between Irwin and Trafford City is 5 miles.

COLUMBIA, S. C.—The Columbia Electric Railway, Light & Power Company proposes to extend its line to the Fair Grounds.

SPARTANSBURG, S. C.—The stockholders of the Spartansburg Railway, Gas & Electric Company have voted a bond issue of $400,000 maximum amount, bearing 5 per cent. interest. Improvements may be made. F. H. Knox is secretary of the company.

ANDERSON, S. C.—The Anderson Traction Company, which is building the city street railway system, has purchased from the Anderson Phosphate & Oil Company a lot on which to erect its power house. A large gas engine will be installed, so that if for any reason the electric power from Portman should fail the cars need not be stopped. Practically all the equipment has been purchased and most of it is being shipped.

YORKTOWN, VA.—There is talk of an electric railway from Hampton to Yorktown and thence to Jamestown, Va., via Williamsburg. O. D. Jackson, of Norfolk, owns the franchise, and the major portion of the right of way has been secured. A large power house is projected at Yorktown.

SPOKANE, WASH.—Jos. Blastina, of Spokane, and F. M. Barrett, of Montana, are considering the advisability of building an electric railway from Spokane to the mines south of Libby.

NEW MARTINSVILLE, W. VA.—An electric railway is to be built between Pennsboro and Harrisville by the Pennsboro & Harrisville Traction Company.

WHEELING, W. VA.—It is stated that the Wheeling & Elm Grove Railroad has been sold to John A. Howard for $1,250,000. Mr. Howard is supposed to represent Col. Henry Schmulbach and others who control the City Railway Company, a traction line with a complete system in this city. The Wheeling & Elm Grove Railroad is a traction line extending from Wheeling to West Alexander, on the Pennsylvania State line, a distance of 16 miles. Mr. Howard, the purchaser and new president of the Wheeling & Elm Grove Railroad, states that it is the purpose of his company to extend the line to Washington, Pa., about 16 miles. This will give Wheeling and Pittsburg direct trolley connection about 60 miles, there already being a traction line from Pittsburg to Washington.

NEW WESTMINSTER, B. C.—The British Columbia Electric Railway shops here burned to the ground Aug. 13. Loss, $50,000. Six cars were burned.

PERSONAL.

MR. GERHARD MAGNUS, electrical engineer, of Christiania, Norway, passed through New York and Chicago this week, en route for St. Louis to attend the International Electrical Congress.

MR. O. L. REMINGTON, of Wm. McLean & Company, electrical engineers and contractors, Melbourne, Australia, has left there for America and Europe. While in the United States his address will be care of the Bullock Electric Manufacturing Company, Cincinnati.

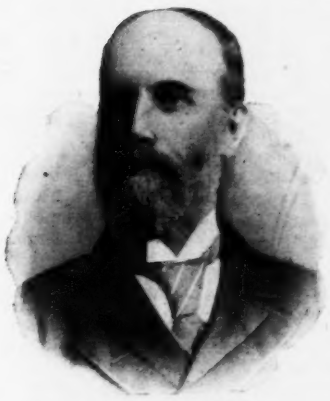
MR. J. A. GORDON, of the International Telephone Manufacturing Company, of Chicago, has recently taken charge of the construction of the public service telephone system for the town of Neepawa, Manitoba, where the town is practically doubling its capacity by installing a large amount of additional cable and enlarged central office equipment.

MR. F. SEJERSTED, manager of the Holmenkollen Electric Railway of Christiania, is on a visit to this country as the representative of the Norwegian Government Railways for the purpose of studying the application of electricity to railway service here as bearing on the proposed conversion of the government roads of Norway from steam to electric power.

MR. EDWARD E. GOUDEY, who resigned recently from the general management of the Goudey-McLean Company to take a partnership interest in the engineering firm of B. F. Bell & Company, is one of the incorporators of the Bell Engineering & Construction Company, of the St. Paul Building, New York. The latter concern is a New York corporation organized to succeed B. F. Bell & Company and carry on the business of consulting and contracting engineers. Mr. Goudey, who is well known in electrical circles, is treasurer of the Bell Engineering & Construction Company.

MR. L. P. HAMMOND.—The Denver Engineering Works Company announces that in order to expedite the handling of their constantly increasing business they have appointed Lyman P. Hammond as sales manager. He has resigned his position as manager of the Denver branch of the Crocker Wheeler Company, and will take charge of all work relating to the sale of the Denver Engineering Works Company's products after September 15. He will be located at the city office of the company, 604-605 McPhee Building, Denver. Mr. Hammond has had a broad experience in the manufacturing industry and has made a good record in the representation of Crocker Wheeler apparatus.

OBITUARY.



RICHARD S. WARING.

MR. RICHARD S. WARING, formerly one of the most prominent citizens of Pittsburg, and the pioneer in underground cable manufacture in the United States, died on Tuesday, Aug. 23, at Elmira, N. Y. He was born in Saratoga County, N. Y., in 1833, and went to Pittsburg about 1856. His first employment there was as book-keeper for the Citizens' National Bank, of that city, whom he served in that capacity for a year; he then entered the employ of R. E. Sellers & Company, manufacturing and wholesale druggists, who, after Mr. Waring had been with them for about a year, built one of the first oil refineries on the Allegheny River near Sharpsburg, and made Mr. Waring the manager of the refinery. In this way he acquired his first experience in the new oil industry. In the winter of 1861-2 he formed a partnership under the firm name of Waring & Gregg, and engaged in the petroleum oil brokerage business. That partnership continued about two years, and was continued under the name of Waring & King. On January 1, 1865, Mr. Waring's brother was taken into the firm. About 1870, Mr. King sold his interest and the firm name was then changed to Waring Bros., in Pittsburg, and Waring Bros. & Company, in the East, where they had important branch offices, warehouses and docks in the three principal export cities of New York, Philadelphia and Baltimore. Mr. Waring's energy and enterprise soon gave him a leading position in the oil business, and he was at one time one of the most prominent and wealthy independent oil refiners of Pittsburg. The business was ultimately absorbed by the Standard Oil Company. Mr. Waring's knowledge of the oil business was extremely useful to him in perfecting his cable system, for it suggested to him and enabled him to produce the most valuable insulating compound from petroleum products, and upon this insulating compound and numberless other features of cable manufacture he promptly secured letters patent both in the United States and in all important foreign countries. One of the most enduring achievements of Mr. Waring was the founding of the Standard Underground Cable Company by him in 1882, a company which has become one of the most prosperous manufacturing corporations of Pittsburg, and one of the most successful in its line in this country. Although there was no demand or market for underground cables in this country when Mr. Waring founded the company, he spent money lavishly in perfecting his cable system and its manufacture, and he lived to see the day when his company was firmly established in the business and its products considered an indispensable necessity. In 1887 Mr. Waring went to England and founded the Fowler-Waring Cables Company, Ltd., for the manufacture of cables of the same type as were manufactured by his American Company. After remaining in London until 1890, he spent about two years in France, principally in Paris, and returned to Pittsburg in 1893. He then interested himself in the Susquehanna Water Power Company, a project intended to utilize the waters of the Susquehanna River for electric power, but about five years ago he was obliged to retire from active business on account of failing health, and had since then resided at Elmira, N. Y. He was a member of the American Institute of Electrical Engineers for a number of years; for many years he was a trustee of the Western University of Pennsylvania, a director of the Morganza Reform School of Western Pennsylvania, and a trustee of the First Presbyterian Church of Pittsburg. He was a broad-minded man, of liberal attainments, kind-hearted and responsive to the appeals of worthy enterprises, many of which have reckoned him among their benefactors. He is survived by his wife, his son, Tracy D. (assistant superintendent of the Perth Amboy Cable Works of the Standard Underground Cable Company), and his daughter, Mrs. James Robinson; his brothers, O. T. Waring, of the Standard Oil Company, and E. J. Waring, of the Standard Underground Cable Company, and his sister, Malvina Waring, of Plainfield. N. J. The funeral services, held in the chapel of the Third Presbyterian Church in Pittsburg on Thursday, Aug. 25, were largely attended by his former friends and acquaintances, and the remains were interred in the family lot in Allegheny Cemetery.

NEW INDUSTRIAL COMPANIES.

THE ELECTRICAL HEATING & MANUFACTURING COMPANY has been incorporated at St. Louis, Mo., with a capital stock of $50,000. The incorporators are C. H. Blanchard, James A. Howe and Frederick F. Shipp.

THE ELECTRICAL MANUFACTURERS' EXPORT COMPANY has been organized with an initial capital of $100,000. The directorate includes the names of D. C. Durland, of New York City; Marshall D. Barr, of Pittsfield, Mass., and F. S. Hunting, of Fort Wayne, Ind.

THE NATIONAL ELECTRIC POWER COMPANY, of Mexico, has been incorporated at Washington, D. C., with a capital stock of $5,000,000. The incorporators are P. H. Burch, Ralph Wormelle, D. F. Pearce and R. K. Van Mater.

LEGAL.

ACCIDENT WITH LIGHTING CURRENT.—The Supreme Court of Iowa in the case of Harter vs. Colfax Electric Light & Power Company has reversed the decision against the defendant. The suit was for personal injury sustained from contact with an electric light wire and lamp in a hotel bathroom. The Supreme Court held: 1. One furnishing electricity is held to the highest degree of care in the construction, inspection, repair and operation of his plant and machinery, but he is not an insurer against all accidents, nor is he responsible in the absence of a showing of want of care. 2. Where a guest in a hotel was injured by coming in contact with an electric light wire, in an action against the one furnishing the electricity, the doctrine of *res ipsa loquitur* did not apply in the absence of evidence that the accident was due to a dangerous current knowingly or even negligently sent into the building. 3. In an action against one furnishing electric power for injuries received to one coming in contact with an electric light wire, evidence held insufficient to show that the wire carried a dangerous current, or such a current as could have caused the injury. 4. A guest in a hotel was injured by an electric shock, owing to an electric light wire falling on him, but it appeared that the wiring was not done by the one furnishing the electrictiy. Held, that in an action against the one furnishing the electricity there was no presumption of negligence on his part which it was necessary for him to rebut. 5. In an action against one furnishing electric power for injuries to one who came in contact with an electric light wire it was error to permit experts to testify that such a shock as plaintiff received might result in locomotor ataxia in the absence of any evidence that plaintiff had any symptoms of such disease.

CROSSING OF PRIMARY AND SECONDARY WIRES.—The Supreme Court of Minnesota has affirmed the judgment for plaintiff of the court below in the suit of Gilbert et al against the Duluth General Electric Company in a "negligence" or fatal accident case. The syllabus of the decision, furnished by the court, is as follows: 1. The evidence supports the claim that plaintiff's intestate came to his death from a shock of electricity received as the result of the crossing of a primary and secondary wire installed by defendant. It appears the former carried 2200 voltage of electricity, and the latter connected with the electric fixtures at the residence of deceased. 2. Evidence to the effect that such wires were strung on the same cross-arm, 16 inches apart, upon poles 100 feet distant from each other, that they had been crossed two weeks before, and again found to be crossed a few hours after the accident, coupled with evidence tending to show that such wires were permitted to sag 4 feet between poles, and that the insulating material was worn off at the point of contact, taken in connection with other evidence introduced, is sufficient to support a verdict in an issue charging defendant with negligence in the construction and maintenance of its wires. 3. Electric companies are bound to use reasonable care in the construction and maintenance of their lines and apparatus. This care varies with the risks to be apprehended from negligence. Where the wires carry strong and dangerous currents of electricity, and the result of negligence may be exposure to death or serious accident, a high degree of care is required. Under such circumstances "reasonable care" and a high "degree of diligence" may be deemed to be synonymous. 4. Parties installing electric light fixtures in houses are not bound to anticipate that electric light companies furnishing electricity to the public will be negligent in either the construction or maintenance of their respective systems connecting therewith, and the installation of a defective electric socket by plaintiff's intestate at his place of residence did not constitute such negligence as will preclude a recovery herein. 5. Opinions of physicians, based upon facts assumed in a certain hypothetical question, held admissible. Other errors assigned do not constitute reversible error.

Trade Notes.

THE ANDERSON PUSH-BUTTON COMPANY, 136 Liberty Street, New York, has filed schedules in bankruptcy showing liabilities of $16,283 and assets of $11,531.

THE COLUMBIA INCANDESCENT LAMP COMPANY cordially invites all visitors to St. Louis in connection with the Electrical Congress to call at the Columbia office, 2115 Locust Street, during their stay in St. Louis.

THE EMPIRE ELECTRIC SUPPLY COMPANY, Chicago, is receiving increased orders, it reports, for Yost sockets and other specialties which it handles. It will be glad to send prices and bulletins to any one interested.

CROCKER-WHEELER COMPANY, through its new Cincinnati office, has received an order from the Kentucky Wagon Manufacturing Company, of Louisville, which is increasing its power plant and installing a 400-kw engine-type generator driven by a Murray Corliss engine.

COLLINS WIRELESS TELEPHONES.—The Collins Marine Wireless Telephone Company, 11 Broadway, New York, has issued a price-list of its apparatus. Two types of wireless telephones are included, one for interior and the other for exterior service. The types are also modified for house, factory,

WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., is issuing a new catalogue, No. 19042, covering its S K N and S U N types of U. S. Government motor controlling panels, which meet the stiff official specifications in every way as well as the requirements of the National Board of Fire Underwriters.

JEFFREY GRAB BUCKETS, said to be "the most powerful ever made"—and they certainly look it—are the subject of a handsome pamphlet just issued by the Jeffrey Manufacturing Company, of Columbus, O. It illustrates neatly and effectively the modus operandi and the utility of the apparatus, especially as applied to electric lighting and street railway power house equipment.

LIGHTNING AND TRANSFORMERS.—The fact that lightning does little injury when it strikes a transformer of the Pittsburg Transformer Company is shown in a convincing manner in a circular recently issued by the company. The circular contains the replies to inquiries to customers as to the transformers. As a general rule the extent of the injury has been just a shattered lid.

THE BISHOP-WILBUR COMPANY has opened an electrical machinery and appliance agency at 612 Mission Street, San Francisco, Cal., with G. A. Wilbur as general manager. Among the concerns represented are the Warren Electrical Manufacturing Company, Sandusky, Ohio; Triumph Electric Company, Cincinnati; Jandus Electric Company, Cleveland, and the Falk Company, Milwaukee, Wis.

FOUR-FARTY TELEPHONE LINES.—The four-party line selective equipment manufactured by the Sterling Electric Company, Lafayette, Ind., is gaining popularity daily. It has just completed shipments to Springville, N. Y.; Cooperstown, N. Y.; Meadville, Pa.; Warren, Pa.; Conneaut, O.; Cedar Rapids, Ia.; Chillicothe, Ohio; Louisiana, Mo.; Pittsburg, Kan.; Hudson, N. Y., and Lorain, Ohio.

CHICAGO FUSE WIRE.—Mr. W. R. Goodman, secretary of the Chicago Fuse Wire & Manufacturing Company, is coming East to take charge of the New York office at 853 Broadway. He will carry in New York a complete stock of fuse wire and fuse links, in addition to which a stock of enclosed fuses is being increased as rapidly as possible. Mr. Goodman has had a great deal of success in selling fuses both at the home office of the company and in its central office in Buffalo, and he brings to this city a ripe experience in fuse manufacture and sale.

MR. J. E. WAY, of the R. Thomas & Sons Company, 39 Cortlandt St., New York, has fitted up a sample room in his new office where specimens of all sorts and shapes of Thomas insulators are to be seen. These run in sizes from the small telegraph type up to those made for heavy power transmission lines where the test is as high as 120,000 volts. In connection with this testing it may be said that the company has installed at its factory some new transformers for testing purposes which are about the largest built for this purpose. In the New York office there are some models of the larger insulators, perfect in every respect, which are intended for souvenirs. The little insulators are only 2½ inches high, but are perfect reproductions in miniature of the type which made the Thomas insulators famous in power transmission work.

T. J. COPE, 3244 North Fifteenth Street, Philadelphia, Pa., has a number of excellent specialties embodied in the Cope system of drawing in underground wires and cables. Their reputation has spread from Philadelphia all over the country, so that Mr. Cope "has the call" on work of this character. His patent conduit threading machine seems to be a device absolutely indispensable for clean, quick work, and it has run ducts 1300 feet between manholes. This system and the detail specialties are the subject of a neat pamphlet just issued by Mr. Cope, with illustrations and descriptions, including also cable racks, swivel racks, wire reels, wire grips, etc.

THE TRUMBULL ELECTRIC MFG. COMPANY, Plainville, Conn., announces that the line of type "A" switches has been increased from 300 to 600 amp. and that it has begun the manufacture of panels and switchboards. Bulletin No. 13, of the company is devoted to pendant switches. This switch is a 10-amp. snap switch operated by a push button. It is ovoidal in shape, compact in construction and very neat in appearance. Its durable qualities will be appreciated when it is known that the switch is guaranteed to operate successfully at its rated capacity (10 amp., 125 volts) 10,000 times without injury, and any switch failing to meet this requirement will be replaced free of charge.

MEYER VALVE GEAR PUMPING ENGINES.—The Meyer-gear engines are designed to meet the increasing demand for pumping engines showing high steam economy at minimum cost for equipment. The distinguishing feature of the gear is the employment of a pair of auxiliary valves, which, working on the back of the main valve and actuated by an independent eccentric, cut off the supply of steam to the cylinder at a point in the stroke determined by their relative positions. The valves are moved by right and left-hand threads on a swiveled stem with a square end, the squared portion moving within the spindle of a stationary hand wheel. Movement of this hand wheel, by moving the auxiliary valves together or apart, lengthens or shortens the cut-off as may be desired. The point in the stroke at which the cut-off may be taking place is indicated by a pointer on the adjusting bracket, and being variable between one-fifth and four-fifths stroke, may be set to suit the load, the governor acting simply to check any dangerous increase of speed or pressure. These engines are manufactured by the Laidlaw-Dunn-Gordon Company, Cincinnati, which has just issued bulletin L 601 describing their construction in detail.

POWER GAS SYSTEMS.—Depending upon the method of operation, these installations may be broadly classified as pressure or suction plants. In the pressure type the air necessary to maintain the fire in the gas generator enters the fuel bed under the pressure caused by a steam jet blower, a fan or similar means, the gas passing through the apparatus reaching the engine under a pressure of 2 or 3 inches of water. The pressure system has the advantage of being able to use a greater variety and an inferior quality of fuel than is possible in the suction type. In this the air required for gas generation is drawn through the fuel bed and the resultant gas passes through the cooling and cleansing apparatus by the suction or draught action of the engine piston. The suction system requires a good quality of anthracite coal, not less than pea size. The suction plant, however, is economical in operation, occupies less space than a pressure plant and its first cost is considerably lower. Equipments for both the pressure and suction systems are manufactured by R. D. Wood & Company, Philadelphia, who have extensive exhibits in the Steam, Gas and Fuels Building and at the U. S. Government Testing Plant at the St. Louis Exposition. They issue a special pamphlet on "Producer Gas and its Industrial Applications," which contains a scientific and complete discussion of this subject.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUG. 30, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

768,084.—CONTACT FOR TELEPHONE OR LIKE CIRCUITS; Walter Axel Wilhelm Emanuel Hjorth, Stockholm. App. filed July 17, 1903.

768,581.—ELECTRICAL APPARATUS; Fred Burks and Charles Rohles, Buffalo, N. Y. App. filed Jan. 23, 1904. A pair of dumb bells containing a generator of electricity, actuated by movement of the bells, and conductors arranged to pass a current through the body of the person using the bells.

768,584.—AUTOMATIC SYNCHRONIZING APPARATUS; Milton C. Canfield, Cleveland, Ohio. App. filed Aug. 3, 1903. (See Current News and Notes.)

768,585.—SIGNALING APPARATUS FOR RAILWAYS; Edward C. Carter, Evanston, Ill. App. filed Jan. 11, 1902. A combustible gas is used as fluid pressure to actuate a signal and also as a fuel to supply a signal lamp burner.

768,606.—SUSPENSION OF TROLLEY WIRES; Martin T. A. Kubjerschky and Paul E. Herner, Berlin, Germany. App. filed March 7, 1902. A clip in which the wire is clamped in such a manner as to afford it free movement.

768,610.—ELECTRIC CONTROLLER; John Lindall, Boston, Mass. App. filed Jan. 13, 1904. The contact pieces are faced with detachable plates which can be renewed at less expense than the renewal of the entire contact would entail.

768,616.—CIRCUIT INTERRUPTER; George P. McDonnell, St. Louis, Mo. App. filed May 10, 1902. A motor drives a commutator which interrupts a bell circuit.

768,617.—SUPERVISORY SIGNAL APPARATUS FOR TELEPHONE SWITCHBOARDS; James L. McQuarrie, Chicago, Ill. App. filed Jan. 2, 1904.

768,630.—ELECTRIC ACCUMULATOR; Constantin de Sedneff, Paris, France. App. filed July 28, 1902.

768,631.—INCUBATOR; Adolphus G. Smith, Boston, Mass. App. filed July 5, 1901. A thermostat in the incubator operates the circuit of an electric heater therefor.

768,634.—ELECTRIC RAILWAY BRAKE; Levi L. Stamm, Almond, N. Y. App. filed Dec. 8, 1903. A motor acts mechanically on the brake rigging of the car.

768,653.—MINE GATE; John P. Cowing, Cleveland, Ohio. App. filed Dec. 17, 1903. Details.

768,674.—TROLLEY FOR ELECTRIC CARS; Lewis M. McBride, Denver, Colo. App. filed Jan. 25, 1904. (See Current News and Notes.)

768,711.—CONTROLLER FOR ELECTRIC MOTORS; Frank C. Watkins, Vallejo, Cal. App. filed Nov. 20, 1903. A pressure gauge controls the circuit of an electric motor.

768,721.—ELECTRODE FOR THERAPEUTICAL PURPOSES; William B. Bassell, Columbus, Ohio. App. filed April 4, 1904. A head-band equipped with electrodes adapted to fit various parts of the head and face.

768,738.—MOTOR GENERATOR; Gano S. Dunn, New York, N. Y. App. filed April 22, 1904. A connecting casting between the cylindrical frames of a motor generator contains a shaft bearing.

768,745.—ELECTRIC ARC LAMP; Melville F. Goodrich, Newton, Mass. App. filed Aug. 13, 1903. A lost motion device whereby the dash pot is at first imposed upon the movable electrode in striking the arc and afterward disconnected through a sufficient range of movement of the movable electrode to permit the regulating movements of the latter independent of the dash pot.

768,764.—RESISTANCE SHEET FOR ELECTRIC HEATERS OR RHEOSTATS; Geo. I. Leonard, Pasadena, Cal. App. filed Sept. 9, 1903. The resistance wire is stitched back and forth through a layer of insulating supporting material.

768,768.—HYGENIC APPLIANCE FOR SOUND TRANSMITTERS; Thomas R. Owen, Los Angeles, Cal. App. filed Jan. 25, 1902.

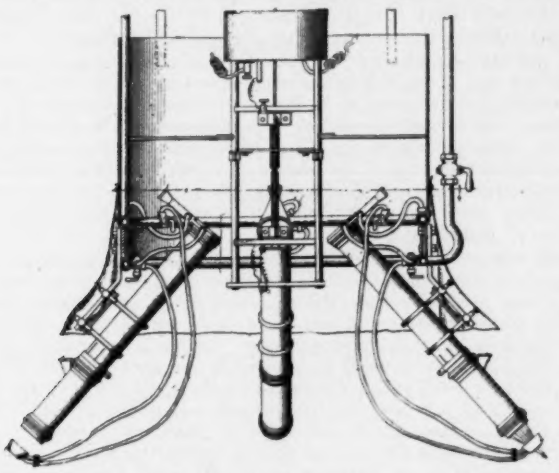
768,778.—WIRELESS TELEGRAPHY; Homer C. Snook, Philadelphia, Pa. App. filed Oct. 23, 1902. The granulated material in the receiver is composed of non-porous carbon which is stated to effectually resist the arcs and to be self-restoring to a great extent.

768,783.—SIGNALING SYSTEM FOR RAILWAYS; George W. Watkins and Walter C. Bethel, Seattle, Wash. App. filed Sept. 8, 1903. A time recorder shows when the train arrives and is operable by the train dispatcher to indicate to the motorman when he shall depart.

768,786.—WEATHERPROOF LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed March 21, 1903. Details.

768,787.—SUB-BASE FOR LAMP SOCKETS; Reuben B. Benjamin, Chicago, Ill. App. filed May 7, 1903. The sub-base is intended to be interposed in a line of molding to permit the wires in the latter to pass through unsevered and to form the base for a lamp receptacle, the terminals of which may be connected by branch wires to the molding wires.

768,789.—TROLLEY POLE CONTROLLER; Martin O. Dolson, Los Angeles, Cal. App. filed Dec. 23, 1903. Pneumatic pressure operates the trolley pole and is controlled by a cord leading to the motorman's station.



768,827.—Apparatus for Treating Diseases by Light Rays.

768,803.—HANGER FOR STREET LAMPS; Arthur W. Hutchins, Providence, R. I. App. filed March 4, 1904. Details.

768,818.—CLEANSING SHEET ZINC; John Nelson, Peru, Ill. App. filed April 30, 1903.

768,827.—APPARATUS FOR TREATING DISEASES BY LIGHT RAYS; Charles F. Stewart, Chicago, Ill. App. filed May 19, 1904. An arc lamp is placed at the axis of a cylindrical casing and throws its rays through a number of tubes radiating from the casing and constructed to be manipulated in the various ways necessary to apply the light.

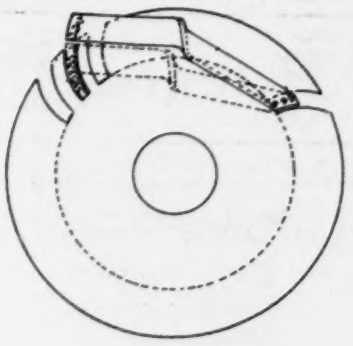
768,843.—ARMATURE; James Burke, Berlin, Germany. App. filed Nov. 2, 1899. The coil slots in the armature are curved to permit the form-wound coils to be adjusted without distortion.

768,847.—ELECTRIC LAMP; Elias L. Elliot, New York, N. Y. App. filed June 5, 1903. A switch for the lamp socket of multifilament lamps.

768,863.—HANGER FOR TROLLEY WIRES; Augustus Neubert, Elizabeth, N. J. App. filed Dec. 10, 1903. Details.

768,864.—CROSSTOWN ARCH FOR INTERSECTING TROLLEY WIRES; Augustus Neubert, Elizabeth, N. J. App. filed Dec. 10, 1903. A hood in the shape of a cross, to be mounted over the crossing point of two trolley wires.

768,868.—AUTOMATIC ELECTRIC CONTROLLING SYSTEM; Wilhelm Stockmeyer, Frankfort-on-the-Main, Germany. App. filed March 18, 1902. An instrument actuated by the difference of potential between two circuits and controlling a resistance located in one of the circuits.



768,843.—Armature.

768,908.—ELECTRIC TIME SYSTEM; David Perret, Neufchatel, Switzerland. App. filed March 31, 1904. An electric clock winder.

768,925.—PLUG SWITCH; James I. Ayer, Cambridge, Mass. App. filed June 11, 1904. A plug receptacle comprising terminals of a current supply circuit and a signal circuit, whereby upon the insertion and removal of the plug, the signal circuit is closed and opened simultaneously with the closing and opening of the consuming circuit.

768,934.—METERING SYSTEM; Thomas Duncan, Lafayette, Ind. App. filed June 6, 1904. (See Current News and Notes.)

768,937.—APPARATUS FOR RECTIFYING ALTERNATING CURRENTS; Charles M. Green, Lynn, Mass. App. filed Oct. 25, 1900. (See Current News and Notes.)

768,939.—AUTOMATIC GOVERNOR FOR AIR COMPRESSORS OR SIMILAR DEVICES; Milan W. Hall, New York, N. Y. App. filed April 2, 1903. Details of an electric switch actuated by the fluid pressure.

768,941.—CIRCUIT BREAKER; Edward M. Hewlett, Schenectady, N. Y. App. filed June 29, 1901. The main contacts are protected from arcing by forming a number of shunt paths which are progressively opened after the main contacts separate.

768,957.—ELECTRICAL MEASURING INSTRUMENT; Homer C. Snook, Philadelphia, Pa. App. filed June 17, 1904. A winding associated with a magnetic field, said winding being maintained at the same potential as juxtaposed parts and means for indicating the extent of reaction between the magnetic field and the field produced by a current passed through the windings.

768,959.—TROLLEY WHEEL; Frederick Strail, Rochester, N. Y. App. filed June 1, 1903. The inner faces of the flanges are concaved to let in bends of the wire and prevent displacement.

768,982.—ELECTRIC METER; Thomas Duncan, Chicago, Ill. App. filed July 11, 1901. A coulomb meter having a main armature winding subject to the current in the system and a supplemental winding subject to the pressure, and means for producing a magnetic field within which the windings are located.

768,993.—WATERPROOF ENTRANCE BUSHING FOR WIRES; Walter B. Hopkins, Providence, R. I. App. filed Dec. 22, 1903. A hood over the open end of a vertical pipe to admit wires and yet protect the pipe from rain.

769,003.—MANUFACTURE OF ELECTRODES OR ARC LAMPS; Maurice Lilienfeld, Berlin, Germany. App. filed March 3, 1903. Consists in mixing with the binding agent luminiferous and light-coloring substances, heating the mixture while stirring to bring the binding agent to the consistency of thin liquid and forming the electrode from the product thus obtained mixed with powdered carbon.

769,005.—OSCILLAPHONE; Walter W. Massie, Providence, R. I. App. filed July 14, 1904. A wave-responsive device consisting of a conductor resting freely across two terminals and held in place by magnetism.

769,009.—AUTOMATIC TROLLEY CONTROLING DEVICE; Horace W. Nichols and Samuel Briggs, Folcroft, Pa. App. filed Jan. 4, 1904. Details of a ratchet and drum arrangement.

769,057.—ELECTRICAL CHOKE COIL; George S. Carson, Iowa City, Ia. App. filed March 30, 1904. The coil is wound upon a core supported in a line conductor and connected at each end therewith.

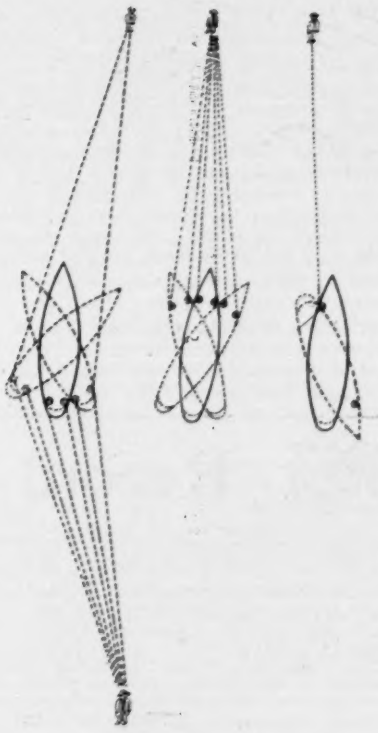
769,058.—RAILWAY SIGNAL; John P. Coleman, Edgewood, Pa. App. filed Dec. 8, 1902. The moving train actuates certain fluid pressure apparatus to control the signal.

769,070.—TROLLEY; Lindley F. Forrester, Foxboro, Mass. App. filed Jan. 16, 1904. The trolley wheel rolls upon two other wheels mounted in the harp.

769,085.—TROLLEY RETRIEVER; William W. Hoffman and Francis W. Powers, West Lafayette, Ind. App. filed Oct. 19, 1903. Details of a ratchet and drum arrangement.

769,086.—TROLLEY HARP; William W. Hoffman, West Lafayette, Ind. App. filed March 24, 1904. Water caught on the trolley wheel is conducted away from the rope by a trough arranged for the purpose.

769,094.—ELECTRIC LIGHTING SYSTEM FOR CARS; Herman Kreusler, Brooklyn, N. Y. App. filed Nov. 28, 1903. A switch for throwing in a battery for lighting purposes whenever the trolley leaves the wire.



769,100.—Submarine Signaling.

769,098.—STARTING DEVICE FOR ALTERNATING-CURRENT INDUCTION MOTORS; Hans S. Meyer, Rugby, Eng. App. filed Nov. 7, 1902. (See Current News and Notes.)

769,100.—SUBMARINE SIGNALING; Josiah B. Millet, Boston, Mass. App. filed July 20, 1903. By using two devices for creating sound impulses and locating them at different points on a vessel, the direction of approach of a vessel can be determined by the directions from which the sound is received from the two sources.

769,113.—FUSE PLUG; Howard R. Sargent, Rugby, England. App. filed March 11, 1903. A porcelain receptacle fitted with contacts and adapted to receive a plug.

769,116.—ELECTRIC SWITCH; Geo. J. Schneider, Detroit, Mich. App. filed Aug. 4, 1903. An automatic switch for the handle of a sadiron heated by electricity.

769,125.—TELEPHONE SUB-STATION OUTFIT; Ernest E. Yaxley, Chicago, Ill. App. filed Dec. 28, 1903.